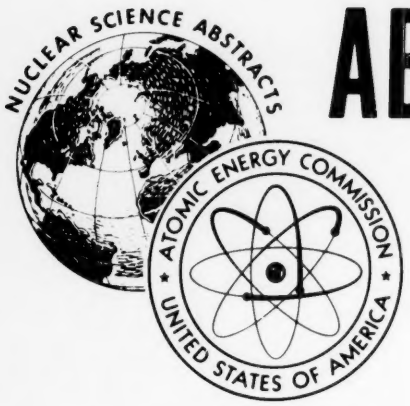
NUCLEAR SCIENCE ABSTRACTS



Volume 27 Number 7

Abstracts 14484-16950

April 15, 1973

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Volume 27, Number 7, April 15, 1973

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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NEWCOMB, William A., Stability of a magnetic well, 25:1239
NEWKIRK, L. R., Superconductivity in the pseudobinary alloys V_3Si--Nb_3Al, 25:1093 (CALT-822-13)
NEWLAND, E. A., Radiation treatment of sewage, 25:140 (AAEC/LIB/Bib-254)

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TRANSURANIUM ELEMENTS
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separation by ion exchange and complex-formation elution, 25:251(P)
TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

is indexed as:

CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

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Use of funds for printing this publication approved by the Director of the Office of Management and Budget, June 19, 1972.

Volume 27, Number 7 April 15, 1973

NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

Analytical Chemistry

Refer also to abstracts 14739, 14976, and 15140.

Activation and Nuclear Reaction Procedures

Refer also to abstract 16049.

14484 (CEA-CONF-2130) APPLICATION OF SEVERAL METHODS OF MICROANALYSIS TO THE STUDY OF LAYERS OF PASSIVATION OF STAINLESS STEEL. Revel, G.; Da Cunha Belo, M. (Centre National de la Recherche Scientifique, Vitry (France)); Meriaux, J. P.; Schneider, C. (Institut National des Sciences Appliquees, Lyon (France)); Hilleret, N.; Bourguillot, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 12p. (In French). (CONF-721010–17). Dep. NTIS (U. S. Sales Only).

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The passivation coatings studied were formed by immersion of samples of industrial stainless steel in boiling magnesium chloride. Following the treatment their thickness varied between several hundred and several thousand Angstroms. The methods of analysis used were activation by neutrons and by charged particles, secondary ionic emission, and atomic ionoluminescence. The elements determined by neutron or charged particle activation are O, Cl, Mg, Ni, Mn, Cr, Fe, and Co. The results obtained are described and intercompared. These experiments demonstrate the interest in combining methods that supply complementary pieces of information. (tr-auth)

14485 (IRI-133-72-10) AUTOMATED CHEMICAL SEPARATIONS IN ROUTINE ACTIVATION ANALYSIS. Tjioe, P. S.; de Goeij, J. J. M.; Houtman, J. P. W. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1972. 22p. (CONF-721010–19). Dep. NTIS (U. S. Sales Only).

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

For environmental studies by neutron activation a separation scheme was developed successfully for arsenic, antimony, cadmium, copper, mercury, selenium, and zinc. It is based on a combination of distillation and ion exchange. Special attention was paid to prevent interference from bromine and sodium. (MCG)

14486 STUDIES ON SOLVENT EXTRACTION TECHNIQUES FOR ACTIVATION ANALYSIS OF SERUM. Appleby, D. E.; Savory, J. (Univ. of Florida, Gainesville). Anal. Chim. Acta; 62: No. 2, 317-324(Dec 1972).

Studies on the possible use in neutron activation analysis of serum of solvent extraction before irradiation are presented. Various chelating solvent extraction systems were studied with and without prior ashing or acid digestion of the serum sample. Solvent extraction eliminates most of the interfering sodium, potassium, and bromine in the extract, but extraction efficiencies of a variety of trace metals were variable and never quantitative. (auth)

14487 SELF-SHIELDING AND SELF-ABSORPTION EFFECTS IN OXYGEN ANALYSIS BY 14-MeV NEUTRON ACTIVATION. Ishikawa, H.; Nakane, M.; Miyake, Y. (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikenjo Kiho; 23: No. 3, 142-6(Sep 1972). (In Japanese).

In comparative 14-MeV neutron activation analysis of oxygen, the neutron and $\gamma + \beta$ ray attenuation difference in the sample and the standard introduces systematic errors. The relation between apparent density of the samples and such attenuation effects was studied. To qualify these systematic errors, the modeled experiments using various absorbers ranging in apparent density from 0.8 to 11.3 were carried out. The results indicated that the total attenuation effect was closely related to the apparent density of the samples. The correction factor (effective absorption coefficient) for total attenuation effect was determined. (auth)

14488 IMPROVED PNEUMATIC TUBE SYSTEM FOR THE DETERMINATION OF SHORT-LIVED ISOTOPES BY 14 MeV NEUTRON ACTIVATION. Adamek, A. (Inst. of Physics, Bratislava). Radiochem. Radioanal. Lett.; 12: No. 6, 297-310(31 Dec 1972).

An automatically controlled rotary drum sample holder enabling storage of both the analyzed and treated samples in one device was developed. New features of the counting station assembly such as housing in an iron shielding box, rotation of counted sample between the two 100 × 100 NaI(Tl) detectors and some improvements in the sequence programmer, were introduced into the previously described dual pneumatic tube transfer system for the analysis of short-lived isotopes activated by fast neutrons. (auth)

14489 NEUTRON ACTIVATION ANALYSIS FOR DETERMINING SULFUR ON PAPER CHROMATOGRAMS. Rakovic, M.; Jaeger, J.; Glagolicova, A.; Prouza, Z. (Charles Univ., Prague). Radiochem. Radioanal. Lett.; 12: No. 6, 339-343(31 Dec 1972).

The possibility of determining sulfur in situ on paper chromatograms by activating samples shielded with Cd in a nuclear reactor core is demonstrated. The reaction $^{32}S(n,p)^{32}P$ was used. Impurities in the paper represented the factor affecting the lower detection limit. For more than 4 and 8γS, precisions higher than ±10 and ±5% can be achieved. The effect of interfering reactions is discussed. (auth)

14490 APPLICATION OF THE METHOD OF ALTERNATING IRRADIATION CONDITIONS TO NEUTRON ACTIVATION DETERMINATIONS OF ALUMINUM, MAGNESIUM, AND SODIUM IN PYROLYTIC GRAPHITE. Kryzhenkova, N. A.; Valieva, M. G.; Lobanov, E. M.; Usmanova, M. M. This paper was summarized in At. Energ. (USSR); 31: No. 6, 625(Dec 1971) as paper No. 551/6359. (In Russian).

Full copy of this paper is held by TIC.

The possibility of determining aluminum, magnesium, and sodium from the radioactive isotope of sodium formed from the original stable isotopes as a result of competing reactions is discussed. The method of alternating irradiation conditions for decoding and quantitative determination of three-component activity induced in those reactions yields an inadequate manifestation of each component in the transition from one set of irradiation conditions to another. The mathematical processing is based on the solution of a system of linear equations describing these successive irradiations. The decoding technique is justified without requiring superposition of similarity conditions when the experiment is conducted under the various sets of conditions. The boundary relations for the concentrations of the analytical components at which the procedure is applicable are derived. The

possibilities of obtaining coarser results as a result of the effect of thermalization of the neutron flux were investigated. Standardization and accuracy of the method in the instrumental variant of neutron activation analysis applicable to pyrolytic graphite are discussed. (auth)

14491 GAMMA ACTIVATION ANALYSIS OF CARBON IN URANIUM AND THORIUM. Gorenko, A. F.; Skakun, N. A.; Shevchenko, G. M.; (and others). At. Energ. (USSR); 34: No. 1, 53-54(Jan 1973). (In Russian).

In the determination of C in U and Th, bremsstrahlung was generated by a W converter with a 30 MeV electron beam causing the reaction $^{12}C(\gamma,n)^{11}C$ to occur in the presence of a fissioning element (U, Th). The halflife, 20.74 min, is convenient for analysis. The C is burned to $^{11}Co_2$, is separated and detected with a NaI(Tl) crystal in a fast-slow coincidence counter. (KSW)

14492 NONDESTRUCTIVE INSTRUMENTAL MONITORING OF FUEL OIL FOR VANADIUM, SODIUM, AND SULFUR. Persiani, C.; Shelby, W. D. (Bayside Research Center, NY). Environ. Sci. Technol.; 7: No. 2, 125-127(Feb 1973).

An analytical method for monitoring commercial grade heating fuel is described. Neutron activation analysis with a Cockcroft–Walton accelerator was used for determining sodium and vanadium. X-ray fluorescence was employed for the assays of sulfur and vanadium. The methods are direct and nondestructive, with little sample preparation time required. Fuel oil samples can normally be monitored in approximately one-half hour. Results for sodium and vanadium are compared to those obtained by atomic absorption. Sulfur values found are in agreement with those reported using the Paar bomb method of analysis. (auth)

14493 CYCLIC ACTIVATION WITH A ^{252}Cf SOURCE. Gage, S. J.; Atkinson, G. D. Jr.; Bouchey, G. D. (Univ. of Texas, Austin). Nucl. Technol.; 17: No. 3, 247-260(Mar 1973).

A 1 milligram ^{252}Cf neutron source is employed for neutron activation analysis studies on short half-life isotopes utilizing a cyclic irradiation-count sequence. A pneumatic, rapid-transfer system is used to transport samples from the irradiation position near a neutron source to the counting position adjacent to a gamma spectrometer. Improved sensitivities are achieved for short-lived isotopes by selecting the optimal or near optimal cyclic policies. Interference-free sensitivities for several isotopes of possible interest were determined and compared to sensitivities achieved by conventional, non-cyclic neutron activation analysis. Enhancement of the short-lived components was demonstrated for complex photospectra. Finally, the usefulness of a cyclic activation-counting procedure with the ^{252}Cf source is demonstrated for the assay of enriched uranium suggesting potential special nuclear materials safeguards applications. (auth)

14494 RADIOACTIVATION ANALYSIS OF THE IRON, COBALT, ZINC, SCANDIUM, CESIUM, AND ANTIMONY IN SOILS AND PLANTS. Rustamov, R.; Orestova, I. I.; Khatamov, Sh.; Kist, A. A.; Tushkova, R. Ya. At. Energ. (USSR); 33: No. 6, 975-977(Dec 1972). (In Russian).

Soil and plant samples were irradiated with reactor neutrons. The γ-spectra of these samples were determined by a spectrometer consisting of a 1024-channel NTA-512B analyzer and a Ge(Li)-semiconductor detector. This method was used for serial analysis of soils and cotton. The degree of depletion of certain trace elements in soils continuously used for cotton growing was determined. The photopeaks 1291 keV (^{59}Fe), 1332 keV (^{60}Co), 1115 keV (^{65}Zn), 1120 keV, 889 keV (^{46}Sc), 796 keV, 605 keV (^{134}Cs), 603 keV (^{124}Sb) were used to determine these elements. The actual sensitivity of the method was 4×10^{-7} g/g for cobalt, 1.8×10^{-7} g/g for scandium, 2×10^{-6} g/g for antimony, 1.4×10^{-6} g/g for cesium, 4×10^{-4} g/g for iron, and 5×10^{-7} g/g for zinc. (auth)

Chemical and Spectral Procedures

14495 (ICP–1017) ANALYTICAL CHEMISTRY BRANCH ANNUAL REPORT, FISCAL YEAR 1972. Shank, R. C. (Idaho Chemical Corp., Idaho Falls, Idaho). Oct 1972. Contract AT-(10-1)-1375. 225p. Dep. NTIS.

The Analytical Chemistry Branch Annual Report presents the non-routine, significant analytical services and supporting development work for FY-1972. The analytical and technical support activities for the Idaho Chemical Programs and other NRTS and outside contractors included mass spectrometry, gas chromatography, atomic absorption spectrophotometry, emission spectrography, x-ray diffractometry, radiochemistry, spectrophotometry, titrimetry, gravimetry, coulometry, quality control, remote techniques, and improvement of equipment and other analytical techniques. Methods added to the analytical chemistry manual are also included. (auth)

14496 (RT/CHI-(72)9) ISOTOPIC ANALYSIS AND CONCENTRATION OF URANIUM AS A ROUTINE CONTROL IN THE EUREX PROCESS PLANT. Pozzi, F.; Trincherini, P. R.; Angelini, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 13 May 1972. 23p. (In Italian). Dep. NTIS (U. S. Sales Only).

The control of the Eurex plant (reprocessing of irradiated fuel elements) namely that concerned with isotopic enrichment and the determination of the concentration of uranium in input products is entrusted to analysis by mass spectrometry. The method used is based on the mixing of the sample with a spike solution of ^{233}U, extraction in a hot cell with organic solvent (methyl isobutyl ketone) precipitation of uranium as peroxide, dissolution of the precipitate, and analysis with mass spectrometer (CH_4 Model B). A detailed description of the method of analysis is presented as well as values of precision. (auth)

14497 (UCID—15527) MANUAL OF CONTROLLED-POTENTIAL COULOMETRIC METHODS. Harrar, J. E. (California Univ., Livermore. Lawrence Radiation Lab.). 27 May 1970. 45p. Dep. NTIS.

Most of the published controlled-potential coulometric methods for inorganic substances including Ce, Eu, I, Mo, Np, Pu, Ru, Tc, U, and Po are listed together with their procedural details and interferences. (auth)

14498 EFFICIENCY OF EXCITATION OF X RAY LUMINESCENCE OF RARE EARTH ELEMENT IONS IN SINGLE CRYSTALS OF LaF_3. Azarov, V. V.; Shcherbina, E. V. Zh. Prikl. Spektrosk.; 17: No. 3, 519-21(Sep 1972). (In Russian).

The x ray luminescence of twofold active ions of rare earth elements was investigated in LaF_3 single crystals. The ions tested may be placed in two groups, distinguished by the magnitude of the capture cross section of the elemental excitation which was evoked by the crystal in its lattice during the absorption of quanta of short-wave radiation. If a comparable number of ions of both groups are present, then during x ray excitation of the sample as a result of energy capture, only the ions with a large capture cross section will luminesce. This action is suggested as a basis for the determination of rare earth elements in low concentration in crystals of LaF_3. (tr-auth)

14499 DETERMINATION OF IODINE IN ORGANIC COMPOUNDS EMPLOYING OXYGEN FLASK COMBUSTION AND MERCURIMETRIC TITRATION. Lalancette, R. A.; Lukaszewski, D. M.; Steyermark, Al (Rutgers–The State Univ., New Brunswick, NJ). Microchem. J.; 17: No. 6, 665-669(Dec 1972).

Iodine in iodine-containing organic compounds is determined by oxygen flask combustion followed by mercurimetric titration. The method is the same as that used in a collaborative study on the determination of bromine and chlorine with the exception that hydrazine is used as the reducing agent instead of alkaline peroxide and the type of buret to be used for the titration is specified. Accuracy and precision are well within the acceptable limits. (auth)

14500 USE OF CHELATES OF β-DIKETONES FOR THE QUANTITATIVE ANALYSIS OF URANIUM AND THORIUM. Fontaine, R. (CEA, Fontenay-aux-Roses, France); Santoni, B.; Pommier, C.; Guiochon, G. Anal. Chim. Acta; 62: No. 2, 337-342 (Dec 1972). (In French).

Thorium and uranium(IV, VI) can be extracted with a solution of 1,1,1,2,2,3,3-heptafluoro-7,7-dimethyloctane-4,6-dione[H(fod)]. Extraction of thorium is quantitative in the pH range 3 to 7, but the pH ranges for quantitative extraction of uranium are very narrow {pH 1.2 ± 0.1 for U(IV) and pH 6 to 7 for U(VI)}. Thorium and uranium(VI) can be determined by gas–liquid chromatography of their extracted H(fod) chelates, the limit of detection being ca. 1 μg of metal with a flame ionization detector; strict experimental conditions are essential to avoid errors from decomposition of the chelates. The thorium and uranium(VI) chelates can be readily separated by temperature programming. (auth)

14501 SOME NEWER EXAMPLES OF THE APPLICATION OF CATALYZED INDICATOR REACTIONS IN TITRIMETRIC ANALYSIS. Weisz, H.; Pantel, S. (Univ., Freiburg i. B.). Anal. Chim. Acta; 62: No. 2, 361-367(Dec 1972).

The principles of the application of catalyzed reactions for the indication of end points in titrimetric analysis are discussed. Some newer examples are given for this type of titration. An argentimetric titration (Cl^-, Br^-, I^-), in which the indicator reaction is followed visually, and three complexiметric titrations in which the indicator reactions are observed photometrically (Mn), biamperometrically (Mn), and thermometrically (Cu), are described. (auth)

14502 CURRENT-SAMPLED POLAROGRAPHIC TECHNIQUES FOR THE MEASUREMENT OF SPECIES REDUCED AT MORE NEGATIVE POTENTIALS THAN THE MAJOR COMPONENT. Bond, A. M. (Univ. of Melbourne). Anal. Chim. Acta; 62: No. 2, 415-424(Dec 1972).

With conventional d.c. polarography, a particular depolarizer cannot be determined accurately in the presence of a considerable concentration of another species which is reduced at more positive potentials. Current-sampled read-out has been suggested previously to improve the situation; this idea was tested experimentally with Zn–Cu, Zn–Cd, Cd–Cu, Cd–U, Cd–Fe, Sn–Fe, and Zn–Pb systems. The read-out of Tast (current-sampled), derivative Tast and pulse polarographic techniques permits determinations of this type to be achieved accurately and conveniently over quite a wide concentration range, provided that a three-electrode potentiostat is used to minimize ohmic iR drop effects. The maximal concentration and the limiting concentration ratio of the two depolarizers were generally fixed more by instrumental than chemical limitations, although at very high concentrations of the major species some evidence of electrochemical interference was found. (auth)

14503 POLAROGRAPHIC METHOD FOR THE DIRECT DETERMINATION OF URANIUM(VI) IN TRIALKYLAMINE SULPHATE EXTRACTS. Lyle, S. J.; Salvadori, I. T.; Stevenson, A. G. (Univ. of Kent, Canterbury, Eng.). Anal. Chim. Acta; 62: No. 2, 431-434 (Dec 1972).

A polarographic method for determining U(VI) in amines was developed, and the application of the method to the determination of U(VI) in commercially derived amine extracts was explored. (DHM)

14504 5,7-DIBROMO-8-HYDROXYQUINOLINE N-OXIDE AS A REAGENT FOR THE SEPARATION AND GRAVIMETRIC DETERMINATION OF CERIUM(IV) AND THORIUM(IV). Bhatia, P. G.; Gupta, R. D.; Bhat, A. N.; Jain, B. D. (Univ. of Delhi). Anal. Chim. Acta; 62: No. 2, 481-484(Dec 1972).

A gravimetric method of determining Ce(IV) is presented that consists of adding ethanolic solution of 5,7-dibromo-8-hydroxyquinoline N-oxide (DBONO), adjusting the pH to 3.5 to 10, filtering, washing the precipitate until free of nitrate, slowly igniting the precipitate, and weighing as CeO_2. For the gravimetric determination of Th(IV) the procedure consists of adding the ethanolic solution of DBONO, adjusting the pH to 8.6 to 10.3, filtering, proceeding as directed for Ce, and weighing as ThO_2. For the separation of Ce and Th the Ce(IV) is precipitated with DBONO at pH 4.0, and the Th(IV) is precipitated in the filtrate at pH 8.6 to 10.3. (DHM)

14505 LUMINESCENCE METHOD OF DETERMINING ZIRCONIUM WITH SALICYLAL-4-AMINOANTIPYRINE. Talipov, Sh. T.; Tashkhodzhaev, A. T.; Zel'tser, L. E.; Khikmatov, Kh. (Tashkent State Univ.). Dokl. Akad. Nauk Uzb. SSR; No. 5, 34-35(1972). (In Russian).

A method has been developed for a quantitative luminescent determination of Zr with salicylal-4-aminoantipyrine (SAAP), by making use of the direct proportional dependence of the intensity of the fluorescing complex on the concentration of Zr within the limits 0.03 to 10 μg/ml. A 10^{-3} mole/l solution of SAAP was added to the test solution, the pH was adjusted, and readings were taken at 554 nm. The addition of Trilon B is recommended where Zr is determined in the presence of large excesses of Fe, Co, Pb, Th, Ni, Ti, Mo, W, and Hf. The error in the Zr determination was 3 to 6%. (KSW)

14506 COPPER, IRON, MANGANESE, STRONTIUM, AND ZINC CONTENT OF MARKET MILK. Murthy, G. K.; Rhea, U. S.; Peeler, J. T. (Dept. of Health, Education, and Welfare, Cincinnati). J. Dairy Sci.; 55: No. 12, 1666-1647(Dec 1972).

Samples of market milk collected in alternate months from February 1967 to February 1968 from cities in the United States were analyzed for copper, iron, manganese, strontium, and zinc by atomic absorption spectrophotometry. Ranges and national averages for trace elements in milk, expressed as milligrams per liter varied as follows: Cu, 0.044 to 0.190 and 0.086; Fe, 0.20 to 1.51 and 0.64; Mn, 0.033 to 0.211 and 0.091; Sr, 0.040 to 0.480 and 0.171; and Zn, 2.30 to 5.10 and 3.28. Statistically, the data showed significant differences among months and locations. Trace element contents in milk from the east were significantly different from those in the west; however, means or per cent differences between areas (except for Sr) were less than 10%. Strontium in milk from the west was higher than that from the east. Strontium means were greater than 0.200 mg per liter in Arizona, California, Colorado, Kansas, Nevada, New Mexico, South Dakota, Utah, and Wyoming. Monthly means for all trace elements showed that Zn was constant throughout the year, whereas other elements were lowest in summer and highest in winter. (auth)

14507 AMPEROMETRIC DETERMINATION OF ZIRCONIUM WITH AZOPYRAZOLONE DERIVATIVES. Popa, Gr.; Cruceru, D.; Greff, C. An. Univ. Bucuresti Chim.; 20: No. 1, 65-70(1971). (In Rumanian).

The polarographic behavior of 1-phenyl-3-methyl-5-hydroxy-4-pyrazolylazo-4'-arsanilic acid was studied. Its use is proposed for the amperometric determination of zirconium. (tr-auth)

14508 SPECTROPHOTOMETRIC STUDY OF THE SYSTEM UO_2^{2+}-SODIUM SALT OF 3-HYDROXY-2[(2-HYDROXY-1-NAPHTHYL)-AZO]BENZENESULFONIC ACID. Popa, Gr.; Vladescu-Dinoiu, L.; Croitoru, V. An. Univ. Bucuresti Chim.; 20: No. 1, 109-119(1971). (In Rumanian).

The study of the formation of this compound necessitated the establishment of better conditions for obtaining good stability so that it could be used for the spectrophotometric determination of the ion UO_2^{2+}. Among the conditions are the following: wavelength, pH, concentration of the reagent, reaction time, and temperature. The spectrophotometric method proposed permits, within certain concentration limits, establishing the concentration of uranyl ion in the presence of elements having analogous properties that are often present with it in its minerals. By means of the spectrophotometric study of this system, the molar ratio of the complex obtained was established as $UO_2^{2+}/R = 1/2$ at the same time as the value of the stability constant: $K_s = 1.03 \times 10^9$. (tr-auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 14770, 14922, 14923, and 15113.

14509 (IAEA-R-770-F) DEVELOPMENT OF RAPID RADIOCHEMICAL METHODS FOR MONITORING ENVIRONMENTAL ALPHA AND BETA CONTAMINATION IN BIOLOGICAL MATERIAL AND FOODSTUFF BY USING A NEW METHOD OF WET-ASHING WITH OH RADICALS IN AQUEOUS SOLUTION. Final Report for the Period July 1, 1969–January 31, 1971. Sansoni, B. (International Atomic Energy Agency, Vienna (Austria)). 1971. 31p. INIS.

A method is described for the destruction of organic material in samples weighing up to one kg. The method, which is used as a first step in the determination of alpha- or beta-emitting radionuclides in environmental monitoring, consists of a wet-ashing procedure based on the oxidation effect of hydrogen peroxide in the presence of ferrous ion catalyst. The oxidation effect is due to the formation of hydroxyl radicals. Typically, the following quantities of materials can be oxidized conveniently in this way: 1000 g of meat, 250 g of flour, 250 g of skim milk powder, 300 g of grass, 150 g of cellulose, or 1000 g of fish. Yields for several radionuclides investigated were found to be comparable to those obtained by other procedures. The main advantage of the method is its capability to deal with such large quantities of materials; further advantages are the use of non-aggressive simple chemicals and the use of comparatively low temperatures. The method can be adapted easily to automatic handling and can also be used as a basis for rapid radiochemical determinations in emergency monitoring. (INIS)

14510 (NP-19632) RADIOMETRIC METHOD OF THE DETERMINATION OF CALCIUM AND IRON IN CEMENT RAW MIX. Gorski, L.; Lubecki, A.; Ostachowicz, J.; Wasilewska, M.; Kurdowski, W.; Lankosz, M.; Molodynska, W.; Osiowski, A. (Inst. of Nuclear Techniques, Krakow (Poland)). 1972. 91p. (In Polish). (INT-18). Dep. NTIS (U. S. Sales Only).

The nondispersive x-ray fluorescence method using ^{109}Cd radioisotope source was applied for a rapid industrial and for "on stream" determination of Ca and Fe in cement raw mix. The total error of the analysis was calculated, resulting ±0.2% CaO for the range of 46 to 51% CaO and ±0.05% Fe_2O_3 for the range 0.9 to 3.0% Fe_2O_3. The error was estimated at the probability level 0.95. The time necessary for the determination of both elements is 2 minutes. The rapid industrial method was tested in a cement plant "Nowa Huta" for two different kinds of cement raw mix, containing either blast-furnace-slog or fly ashes. (auth)

14511 (RFP-Trans-121) GAS CHROMATOGRAPHIC ANALYSIS OF ATMOSPHERIC GAS POLLUTANTS USING A METASTABLE HELIUM DETECTOR. Castello, G.; Munari, S. Translated from Chim. Ind. (Milan); 51: No. 5, 469-75(1969). 19p. Dep. NTIS.

Numerous possible gaseous atmospheric pollutants were separated and measured at the same time in concentrations in the order of one part in one billion without preliminary enrichment. This was obtained through the use of gas–solid or gas–gel chromatographic columns using a metastable helium detector. (auth)

14512 (RT/FI-(72)30) NONDESTRUCTIVE ANALYSIS OF ANCIENT BRONZES. Cesareo, R.; Sciuti, S.; Marabelli, M.

(Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 26 Jul 1972. 33p. Dep. NTIS (U. S. Sales Only).

Measurements are described that were carried out on a considerable number of ancient bronzes using a portable radioisotope x-ray fluorescence (XRF) unit. This unit allows, in a nondestructive way, the quantitative determination of copper, zinc, tin, and lead in bronzes and brasses in a measuring time of about 100 seconds. The XRF results are in good agreement with those obtained with traditional methods. (auth)

14513 DETERMINATION OF MAJOR AND SOME MINOR CONSTITUENTS IN LEAD ZIRCONATE–TITANATE COMPOSITIONS BY X-RAY FLUORESCENCE AND ATOMIC ABSORPTION SPECTROMETRY. Van Willigan, J. H. H. G.; Kruidhof, H.; Dahmen, E. A. M. F. (Twente Univ. of Tech., Enschede, Netherlands). Anal. Chim. Acta; 62: No. 2, 279-287(Dec 1972).

An accurate x-ray fluorescence spectrometric method is described for the determination of lead, zirconium, and titanium in lead zirconate–titanate ceramics. Careful matching of samples and standards by a borax fusion method resulted in a relative standard deviation of about 0.2% for the major constituents. The determination, after separation, of the unreacted oxide of lead by atomic absorption spectrometry, and of the unreacted oxides of zirconium and titanium by x-ray fluorescence spectrometry is also described. An x-ray fluorescence spectrometric method is proposed for the determination of dope elements (K, La, Sm, Yb) with internal standards (Ca, Ce, Cr, Ni respectively). The magnesium dope is determined by atomic-absorption spectrometry with standard addition. (auth)

14514 DETERMINATION OF TRACES OF URANIUM, THORIUM, AND LEAD BY X-RAY FLUORESCENCE. STUDY OF SOME SYNTHETIC ZIRCONS AND APPLICATION TO SOME NATURAL ZIRCONS FROM GREENLAND. Voldet, P. (Departement de Mineralogie, Geneva). Anal. Chim. Acta; 62: No. 2, 297-304(Dec 1972). (In French).

A method is proposed for evaluating uranium, thorium, and lead in zircons by means of x-ray fluorescence, based on the measurement of the intensities of the $L\alpha^{1}_{1,2}$ line for uranium and thorium and the $L\beta^{1}_{1,2}$ line for lead. With 100 mg of zircon as a compressed tablet, the following contents were determined: 100 to 2000 ppM of uranium, 100 to 300 ppM of thorium and 100 to 400 ppM of lead. The relative error lies between 0.50% and 5.00%. This method is applicable to zircons older than 1700 million years. (auth)

14515 OPROBOVANIE RADIOAKTIVNYKH RUD PO GAMMA-IZLUCHENIYU. (Assay of Radioactive Ores by Gamma Radiation). Shashkin, V. L. Moscow; Atomizdat (1972). 184p.

This book describes methods of assaying U and Th ores by the γ-radiation in natural beds. The spectra of such γ-radiation and methods of measuring it are elaborated on by reference to conversion coefficients of finite and semi-finite media, effective atomic numbers in rocks and ores, and calibration methods. Radioactive equilibria in natural ores and disturbances to these equilibria are discussed. Gamma logging through measurement in bore-holes is considered both for homogeneous and non-homogeneous media. Gamma-spectrometric methods of assay of U and Th separately are described. 96 references. (KSW)

14516 APPLICATIONS OF LOW ENERGY X- AND GAMMA RAYS. Third Symposium Held at Boston, Massachusetts, June 10–12, 1970. Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971). 474p. (CONF-700611).

Separate abstracts were prepared for 29 of the papers in this volume. Another paper has already appeared in NSA as 24: 38697. The three remaining papers, The Application of Moessbauer Spectrometry to Lunar and Terrestrial Rock Samples, In Vivo Flow Studies by Means of Excited X-Ray Characteristic Radiation, and Moessbauer Spectroscopy of the Undecapeptide of Cytochrome c, were not in the subject scope of NSA. (RWR)

For abstracts of individual papers see: 14517–14528, 14659, 14770–14773, 14919, 14920, 14976–14978, 14987–14991, 15179, and 16401.

14517 PPM MEASUREMENTS OF IRON-IN-OIL BY RADIOACTIVE X-RAY FLUORESCENCE ANALYSIS. Gehrke, R. J. (Idaho Nuclear Corp., Idaho Falls); Packer, L. L.; Woody, B. A.; Bruton, W. A. pp 33-48 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From 3rd symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

A study was undertaken to develop the state-of-the-art of nondispersive x-ray fluorescence spectroscopy for the determination of low-level concentrations of Fe so that on-line wear metal analysis can be developed for gas turbine aircraft engines. An evaluation was made of ^{238}Pu, ^{244}Cm, $^{238}Pu/Cu$, $^{244}Cm/Cu$, ^{71}Ge, ^{73}As, $^{147}Pm/Ni$, $^{147}Pm/Cu$, and $^{147}Pm/Zn$ as x-ray fluorescence sources. The techniques presented for selecting an x-ray fluorescence source to determine low-level concentration of Fe in oil can be applied to other matrices and elements. (DHM)

14518 ^{109}Cd X-RAY ABSORPTION TECHNIQUE FOR THE MEASUREMENT OF SULFUR DIOXIDE IN STACK GASES. Pfeifer, R. J.; Cho, B. Y.; Utt, O. L. (Industrial Nucleonics, Columbus, OH). pp 115-22 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From 3rd symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The development of a radiometric method for continuously monitoring the SO_2 content in stack gases is described. The method is based on measurement of the absorption of ^{109}Cd-excited x-radiation and on chemical substitution of Hg for SO_2. Performance data for this measuring system are presented. (L.C.L.)

14519 X-RAY FLUORESCENCE MEASUREMENT OF LIGHT ELEMENTS IN ORES. Hanser, F. A.; Sellers, B.; Brinkerhoff, J. M. (Panametrics, Waltham, MA). pp 137-46 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From 3rd symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The use of a thin window, Ne-fill proportional counter, and a He atmosphere allows fluorescent x-ray measurements to be made for elements with Z as low as 13 (Al). For many applications such as ore analysis, the matrix composition is sufficiently constant to allow accurate measurements to be made with balanced filters, and in some cases without filters. The system can be made portable if a small He bottle is used, and response times with a few l/min He flow will generally be on the order of a few minutes. Use of the sample dilution method with balanced filters, and one known sample and one blank sample, allows absolute determination of a particular element concentration to be made. The system has great promise for the rapid assay of ore samples, as well as other applications requiring the measurement of low Z elements. (auth)

14520 X-RAY INTENSITY MEASUREMENTS FROM ORES USING SEMICONDUCTOR DETECTORS AND RADIOISOTOPIC EXCITATION. Burkhalter, P. G. (Naval Research Lab., Washington, DC). pp 147-63 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From 3rd symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Sensitivities below 100 ppM for high-Z elements in ores are possible because of the good stability of radioisotopic excitation and detecting x-rays with semiconductor detectors. The use of monoenergetic excitation with γ-emitting or electron-capture radionuclides was found to be excellent for both single and multi-element x-ray excitation in ores. Computer techniques used in nondiffractive x-ray analysis for determining x-ray intensities detected in semiconductor systems are described. (DHM)

14521 MEASUREMENT OF NICKEL IN ORES CONTAINING LARGE AMOUNTS OF IRON. Brinkerhoff, J. M.; Sellers, B.; Hanser, F. A. (Panametrics, Waltham, MA). pp 165-71 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From 3rd symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

A method for determining nickel in ores by nondispersive x-ray spectroscopy is described wherein so-called "balanced filters" are used. One filter is placed over the radiation detector and the corresponding number of counts from the proportional counter measured for some fixed length of time. The other filter is placed over the detector and the scaler is set to count backward and the output generated represents the difference in transmission by the two filters. The principle that is utilized is that every chemical element has a so-called "absorption edge" at which there is an abrupt change in the absorption characteristic. When cobalt and iron are chosen as the filter materials, the K-fluorescence of all materials other than nickel are essentially the same, whereas for nickel fluorescence, the transmissions are markedly different. Since the output is taken as the difference in count obtained for the two foils, the output is nearly zero for materials such as Fe, Al, etc., but large for nickel. (DHM)

14522 TECHNIQUES FOR ENHANCING SENSITIVITY OF X-RAY FLUORESCENCE ANALYSIS OF ROCKS. Tanner, A. B. (U. S. Geological Survey, Washington, DC); Brinkerhoff, J. M.

pp 173-85 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From 3rd symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The use of nondispersive x-ray fluorescence spectroscopy in the prospecting for minerals is explored. All elements excluding rare earths can be determined from Cu (Z = 29) to U (Z = 92). Some topics discussed are: configuration of source, target, collimators, and detector; source selection; choice of background materials; computation of sensitivity for gold; and development of instrumentation. (DHM)

14523 COMBINED X-RAY NEUTRON EXPERIMENT FOR THE EXPLORATION OF LUNAR AND PLANETARY SURFACES. Trombka, J. I. (Goddard Space Flight Center, Greenbelt, MD); Adler, I.; Schmadebeck, R. L.; Senftle, F. pp 205-19 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From 3rd symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

A combined x-ray and neutron-gamma ray system shows great promise for elemental lunar and planetary surface elemental compositional analysis. This experiment can use alpha and x-ray sources to produce x-ray fluorescence of surfaces. It is believed that compositional analyses can be obtained for elements from Na through Zn. In addition both accelerator and isotopic neutron sources can be used to perform elemental analysis for major and for some minor trace elements. The x-ray system yields information on the micron depth level while the neutron methods yield information down to about two feet. A comparison of results from the two measurements should yield information of the vertical compositional distribution in lunar and planetary surfaces. A complete system is now under development. The system includes the excitation sources, detectors and associated electronics, a Multiplex Data Accumulator, and an on-line data analysis system. (auth)

14524 RADIOGENIC HEAT MEASUREMENTS IN ROCK BY HIGH RESOLUTION LITHIUM-DRIFTED GERMANIUM SPECTROSCOPY. Russell, I. J. (Boston Coll., Chestnut Hill, MA). pp 221-37 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

High resolution Ge(Li) spectroscopy is a useful and convenient method for determining the relative concentrations of uranium, thorium, and potassium in rocks of arbitrary shape for certain purposes. The accuracy of the method is typically about 15%. If the potassium content of the rock is independently determined to high precision, then heat input due to radiogenic decay can be calculated to satisfactory accuracy for rocks having .5% and greater of potassium, and 1 and 2 ppM by weight, respectively, of uranium and thorium. The method can be adapted to routinely assaying rock samples in a self-consistent manner; with a single detector analyzer setup approximately one to two samples per day can be assayed, or approximately 500 per year. The results are directly applicable to studies of the chemical coherence of uranium and thorium in a variety of geological formations, and to estimating detailed lateral and horizontal heat fluxes due to radiogenic heat in rock bodies of geological interest. (auth)

14525 IN-SITU DETERMINATION OF LEAD ON PAINTED SURFACES FOR THE PREVENTION OF CHILDHOOD LEAD POISONING. Lauer, G. R. (New York Univ. Medical Center, NY); Kneip, T. J.; Albert, R. E.; Kent, F. S. pp 289-301 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Calibration experiments have shown that the x-ray fluorescence method for determining lead using ^{109}Cd Ge(Li) system is capable of detecting a single coat of paint containing 3% Pb beneath at least 10 coats of non-lead paint. On a weight per weight basis, as it is generally expressed, this is equivalent to a detection level of approximately 0.40% Pb, as shown by chemical analysis of the paint on the surfaces tested. (DHM)

14526 APPLICATION OF A Si(Li) SPECTROMETER TO X-RAY EMISSION ANALYSIS OF THIN SPECIMENS. Rhodes, J. R.; Pradzynski, A.; Sieberg, R. D.; Furuta, T. (Columbia Scientific Research Inst., Austin, TX). pp 317-34 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The results of the experiments described clearly show the high potential of the radioisotope x-ray analysis system developed here, for x-ray emission analysis of thin specimens. The combination of the thin film approach and sample preconcentration by deposition on, for example, filter papers, membrane filters or ion-exchange resin-loaded filter papers, opens up the possibility of applying this system to multielement trace analysis. This was exemplified by the attainment of sensitivities in the tens of ppB range for determination of wear debris in engine oil. Many more applications in this class of analysis are possible; for example, body fluids such as urine, blood, spinal fluid, serum. Since the thin film approach enables the avoidance of interelement effects, the method can be used for accurate determination of major elements without the need for complex corrections, as long as the specimen can readily be prepared as a thin film. (auth)

14527 CHEMICAL ANALYSIS FROM PHOTOELECTRON SPECTROSCOPY. Wood, J. K. (Utah State Univ., Logan). pp 417-28 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

A brief survey of photoelectron spectroscopy brings attention to some of the kinds of equipment available, some of the general characteristics of the methods, and a few of the problems that have been approached with the technique. The specimen can be small, it is relatively easy to prepare, and a qualitative analysis of the results can be obtained almost by inspection of the graphed data. The environment of the specimen is austere while the spectrum is obtained but many delicate materials have yielded good spectra. The work done thus far indicates that high resolution electron spectroscopy can be applied to a wide variety of problems with relative ease. The fact that the analyses can be made with both light and heavy elements in molecules of almost any size will prove useful in many research fields. (auth)

14528 PARTICLE SIZE HETEROGENIETY PHENOMENA IN X-RAY ANALYSIS. Berry, P. F. (Nuclear Chicago Corp., Austin, TX). pp 429-50 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Results of a study oriented toward developing the principles of radiometric techniques for compensating for particle size effects in x-ray fluorescence analysis and the determination of particle size in mineral ore streams are presented. The ability of the theoretical model to predict the effects of particle size on the fluorescent, transmission and backscattered x-ray intensity was well demonstrated. Excellent agreement with published and acquired experimental data was obtained, not only for simple matrices containing two particulate phases of equal particle size but also for multicomponent mixtures (powders and slurries) and for nonequal particle size distributions. The model is also capable of explaining the mutual effects of particle size and chemical composition. The establishment of a self-consistent and readily calculable formula is but the first step toward a rational deployment of instrumental techniques for size analysis and compensated x-ray fluorescent analysis of granular materials. Each potential application clearly requires a careful study of all parameters and this is most effectively carried out initially using the theoretical model. (auth)

14529 SCINTILLATION METHOD FOR THE MEASUREMENT OF THE RADON CONCENTRATION. Markov, K. P.; Ryabov, N. V.; Stas, K. N. Yadern. Priborostr.; No. 12, 170-83(1970). (In Russian).

A detailed survey is given of the work on the scintillation method for the measurement of the radon concentration in air. The basic parameters determining the sensitivity and stability of the apparatus based on this method were examined. Data were reported on the optimum volume of scintillation chambers. Methods for the reduction of the natural background and the reduction of the contamination of the chamber during the time of measurement were examined. A brief description is given of a series of domestic and foreign devices based on the scintillation method of measuring radon concentration. (7 tables) (tr-auth)

14530 USE OF SEMICONDUCTOR GAMMA DETECTOR FOR ANALYSIS OF URANIUM WITH X RADIATION. Mironov, I. I.; Suetnov, O. N.; Baldin, S. A. Yadern. Priborostr.; No. 12, 101-9(1970). (In Russian).

Questions on the measurement of isotopic compositions and elementary content of uranium with K characteristic x radiation by use of a semiconductor spectrometer were considered. It was shown experimentally that by use of the semiconductor detector

with a volume of 2.3 cm^3 the isotopic ratio $^{235}U/^{238}U$ can be measured irrespective of the dimensions and weight of the samples of equilibrium uranium within wide limits with satisfactory precision. (2 figures, 2 tables) (tr-auth)

14531 SIMPLE MICRORADIOMETRIC TECHNIQUE FOR THE RAPID MEASUREMENT OF MONOAMINE OXIDASE ACTIVITY IN RAT TESTICULAR MINCED AND TEASED-TUBULAR PREPARATIONS. Urry, R. L.; Jaussi, A. W.; Ellis, L. C. (Utah State Univ., Logan). Contract AT(11-1)-1602. Anal. Biochem.; 50: No. 2, 549-57(Dec 1972).

Two radiometric ways of measuring monoamine oxidase activity in testicular tissue preparations are described. Both methods measure the rate of conversion of 5-HT-^{14}C into 5-HIAA-^{14}C. The first procedure is acceptable for assaying MAO activity of teased-tubular preparations, but not of whole testicular tissue. The second procedure is acceptable for either type of preparation and is the preferred assay for testicular tissue. (auth)

14532 RADIOMETRY AND IDENTIFICATION OF ALPHA-ACTIVE ISOTOPES OF THICK AEROSOL SAMPLES. Bad'in, V. I.; Zalmanzon, Yu. E.; Nikitin, V. I.; Chutkin, O. A. Yadern. Priborostr.; No. 12, 204-15(1970). (In Russian).

The possibility for determining the isotopic composition of thick samples was shown. Corrections on the radiation yield and efficiency of its detection for these samples were determined. (5 figures, 1 table) (tr-auth)

14533 AUTORADIOGRAPHIC DETECTION OF ^{3}H-RNA FRACTIONATED BY POLYACRYLAMIDE GEL ELECTROPHORESIS. Amaldi, P. (Laboratorio de Biologia Cellulare, Rome). Anal. Biochem.; 50: No. 2, 439-41(Dec 1972).

A technique was devised which combines electrophoresis on polyacrylamide gel with autoradiography, to analyze small amounts of tritium-labeled RNA. The sensitivity of the method was increased by working with thin gel slabs produced in a polymerization chamber. (MCG)

Separation Procedures

14534 (IAE-2125) T-Σ-N AND SEPARATION OF ACTINIDE ELEMENTS. EXTRACTION OF TRANSPLUTONIUM ELEMENT NITRATES BY NORMAL ALKYL AMINES. Chudinov, E. G.; Pirozhkov, S. V.; Bebikh, G. F.; Kuznetsova, L. K. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 24p. (In Russian). INIS.

The extraction of tetravalent Am, Cm, Bk, Cf, and Es by trialkylammonium nitrates with different alkyl substituents was studied. Methyl-containing amines extracted Am significantly better than Cf and Cm; long-chain symmetrical amines extracted Cf better than Am. The distribution coefficients of all elements were lowered by increased length of the carbon chains; this trend was particularly noticeable in the case of methylamines. This extraction dependence of chain length may be important in the practical separation of elements. (tr-auth)

14535 SEPARATION OF MOLYBDENUM(VI) AND TUNGSTEN(VI) FROM IRON(III). Teodorovich, I. L.; Mechos, Kh. Z.; Vinitskaya, M. M. (Inst. of Chemistry, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 12, 34-5(1971). (In Russian).

In this separation process a mixture of Mo, W, and Fe was treated with a HCl/HNO_3 mixture, and 1% gelatin added. The solid tungstic and molybdic acids were filtered. Mo was subsequently determined polarigraphically and amperometrically. Data are presented on the separation of Mo from Fe in solution using a base; 10 N KOH (pH of >14.2) was necessary. (KSW)

14536 RADIOCHEMICAL STUDIES ON THE LIQUID–LIQUID EXTRACTION OF SEVERAL ELEMENTS IN FUSED MANGANESE NITRATE HEXAHYDRATE–TRI-n-BUTYL PHOSPHATE IN VARIOUS DILUENTS. Akatsu, E.; Aratono, Y. (Japan Atomic Energy Research Inst., Tokai). Anal. Chim. Acta; 62: No. 2, 325-335 (Dec 1972).

The liquid–liquid extraction of several elements including lanthanum series, Pa, Np, U, Th, and some fission products, was radiochemically studied in several fused manganese nitrate hexahydrate (m.p. 25.8°)–tri-n-butyl phosphate–diluent systems at 30°C: the diluents were xylene, chloroform, and 1-hexanol. The distribution ratios of several elements were higher than those in nitric acid systems with each diluent. The dependence of the distribution ratios on various diluents was almost similar to that in nitric acid systems. (auth)

14537 SELECTIVE SEPARATION OF THORIUM FROM RARE EARTHS, ZIRCONIUM, AND OTHER ELEMENTS BY CATION-EXCHANGE CHROMATOGRAPHY IN HYDROBROMIC ACID MEDIA. Strelow, F. W. E.; Boshoff, M. D. (National Chemical Research Lab., Pretoria). Anal. Chim. Acta; 62: No. 2, 351-359(Dec 1972).

Thorium can be separated from La, Sc, Zr, Ti(IV), Ba, Ca, Mg, Al, Mn(II), Fe(III), Bi(III), Pb(II), Pd(II), Zn, Cu(II), Ni(II), U(VI), and V(V) by eluting these elements with 5.5M hydrobromic acid from a column of AG50W-X4 cation-exchange resin. Thorium is retained and can be eluted with 5M nitric acid with recoveries of better than 99.9% for amounts from about 200 μg to more than 400 mg. Au(III) and Ga(III) can be eluted with 0.5M hydrobromic acid in 90% acetone before the elution with 5.5M hydrobromic acid. Y, Ce, the other rare earths, Sr, Be, Hf, Cr(III), Co(II), Cd, In, Hg(II), Li, Na, K, Rb, Cs, Sn(IV), Ge(IV), Se(IV), Te(IV), As(III), Sb(III), Pt(IV), Ir(III), Ir(IV), and Rh(III) have not been investigated quantitatively, but should also be separated according to their distribution coefficients and elution curves. Some relevant distribution coefficients, elution curves and results for the analysis of synthetic mixtures are presented. (auth)

14538 ADSORPTION BEHAVIOR OF VARIOUS METALS ON A WEAKLY BASIC ANION-EXCHANGE RESIN IN SULFURIC ACID MEDIA. Kuroda, R.; Oguma, K.; Kono, N.; Takahashi, Y. (Chiba Univ., Japan). Anal. Chim. Acta; 62: No. 2, 343-349 (Dec 1972).

A systematic study is presented on the adsorption behavior of some 20 metals, including U(VI), Mo(VI), Th(IV), Sc(III), Y(III), rare earths(III), and Zr(IV), on a weakly basic condensed phenol resin, Amberlite CG-4B, in sulfuric acid media. The distribution coefficients were determined over a sulfuric acid concentration range of 0.005 M to 2 M. The metals adsorbed are similar to those which exhibit strong adsorption on a strongly basic resin, but the magnitudes of the distribution coefficients and the adsorption sequences differ considerably between the two types of the resin. Several two- and three-component separations of analytical interest are possible. A new method for the separation of titanium(IV) is described; this is based on its high adsorption on CG-4B from sulfuric acid media containing hydrogen peroxide. (auth)

14539 PURIFICATION METHODS FOR LANTHANUM. 2. EFFECTS OF THE COEXISTENCE OF SEVERAL COMPLEXING AGENTS DURING THE FORMATION OF OXALATE AND FORMATE ON THE REMOVAL OF RARE EARTH ELEMENTS. Ishii, E.; Miyake, Y. (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikenjo Kiho; 23: No. 3, 160-6(Sep 1972). (In Japanese).

The precipitation of La as formate in the presence of complexing agents is the most desirable method, as the precipitate is obtained from the homogeneous solution. Among the complexing agents, DTPA is more advantageous than EDTA, DCTA, and NTA, because of the difference of the stability constant between the chelate of rare earth elements and that of La. In the proposed method, the co-precipitation ratio of rare earth elements to lanthanum was obtained 0.38 (Pr) ~ 0.04 (Eu), when the amount of DTPA added was 10% equivalent of lanthanum. Eleven impurity elements at each stage of the purification process were determined by a spectrographic method. (Japan)

14540 SEPARATION AND ANALYSIS OF RARE EARTH ELEMENTS BY REVERSED PHASE PARTITION CHROMATOGRAPHY. 3. STUDY OF FUNDAMENTAL CONDITIONS WITH COLUMN CHROMATOGRAPHY. Higashi, K.; Miyake, Y. (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikenjo Kiho; 23: No. 3, 147-52(Sep 1972). (In Japanese).

The separation of cerium-group rare earth elements was studied by reversed phase partition column chromatography. The effects of the support, flow rate, elution temperature, and the amount of sample on the elution curve were examined. As the extracting reagent, di(2-ethylhexyl) phosphate (HDEHP) was used because of its large separation factor for rare earth elements. Hydrochloric acid was used as an eluent. As a support, trifluorochloroethylene was suitable on account of the surface state, the adsorption property for HDEHP and the inertness to an eluent. Elements were separated satisfactorily under the condition of 0.5 to 1.0 $ml/cm^2/min$ and 50°C. As the amounts of loaded HDEHP and sample increase, a height equivalent to a theoretical plate increases. Using the gradient elution method, lanthanum, cerium, neodymium, and samarium were separated, however the separation of cerium, praseodymium, and neodymium was difficult. (auth)

14541 EXTRACTION OF SELENIUM(IV) AND TELLURIUM (IV) FROM HYDROCHLORIC ACID SOLUTIONS WITH SOME BENZAZOLES. Doycheva, R. G.; Anghelova, V. H. (Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 10, 1359-1362(1972).

The solvent extraction behavior of Se(IV) and Te(IV) was investigated in relation to compounds containing O, N, and S in various combinations, such as benzazoles. Only chloroform solutions of benzazoles containing a mercapto group extract Se(IV) in an organic phase from HCl. Separation of Se from Te was achieved. (MCG)

14542 PROCEDURE FOR THE SEPARATION OF YTTRIUM FROM THE ELEMENTS LANTHANUM TO LUTETIUM BY MEANS OF THE DISTRIBUTION OF THEIR THIOCYANATES. Fischer, W.; Schmitt, F. (to Goldschmidt (Th.) AG). German Patent 1,592,120. 22 Jun 1972. (In German).

A method is presented for the separation of yttrium from the elements lanthanum to lutetium by means of solvent extraction of their thiocyanates. The ratio of thiocyanate to rare earth should not exceed the equivalent ratio. The rare earths are used in the form of aqueous chlorides, the thiocyanate is preferably ammonium thiocyanate; the organic phase can be an oxygen-containing solvent, e.g., ester, ether, or ketone. The characteristic feature of the separation method is the working temperature below room temperature, between 5°C and the cryohydratic point of the aqueous phase. A multistep counter-current equipment is used. (Germany)

14543 EXTRACTION OF BENZENE-, ETHANE-, AND METHANESULFONYLBENZAMIDE OXIMATES OF RUTHENIUM (VI). Klimkovich, E. A.; Usatenko, Yu. I.; Fedorova, N. G. (Dnepropetrovsk Chemical-Technological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 15: No. 9, 1312-1315(1972). (In Russian).

In a study of the extraction of Ru complexes by a butanol–chloroform mixture, a solution of sodium ruthenate was added to solutions of benzene-, ethane-, and methanesulfonylbenzamide oxime, and extraction tests were made with chloroform. Distribution constants and instability constants of the Ru complexes were obtained. Salting-out of the complexes by anions was tested; the comparative effectiveness in salting-out was represented by the series: $SO_4^{2-} > HPO_4^{2-} > WO_4^{2-} > NO_3^- > Ac^-$ (for the Ru-methane complex), or $SO_4^{2-} > NO_3^- > HPO_4^{2-} > WO_4^{2-} > Ac^-$ (for the Ru-ethane complex). (KSW)

14544 COMPLEX FORMATION IN THE SYSTEMS DYSPROSIUM (HOLMIUM)–ALIZARIN S AND DYSPROSIUM–ALIZARIN S–CALCIUM. Usatenko, Yu. I.; Tolubara, A. I.; Kochubei, A. I. (Dnepropetrovsk Chemical-Technological Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Khim. Khim. Tekhnol.; 15: No. 9, 1308-1311(1972). (In Russian).

Alizarinates of Dy(Ho) were formed in weakly alkaline solutions in the ratios 1:1 and 1:3 with light absorption maxima at 530 and 510 nm. Extraction by butanol was insignificant. A triple complex was formed in the system Dy(Ho)–Ca–alizarin S at a pH of ~8.0, having a molar ratio of reacting components 1:1:5 and 1:2:5, with a maximum light absorption at 520 nm. The positively charged triple complex was extractable with butanol. (KSW)

14545 PURIFICATION METHODS FOR LANTHANUM. 1. BEHAVIOR OF SMALL AMOUNTS OF THE RARE EARTH ELEMENT DURING THE FRACTIONAL CRYSTALLIZATION OF AMMONIUM LANTHANUM NITRATE AND THE REMOVAL OF CERIUM. Ishii, E.; Miyake, Y. (Government Industrial Research Inst., Osaka). Osaka Kogyo Gijutsu Shikenjo Kiho; 23: No. 3, 153-9(Sep 1972). (In Japanese).

In an attempt to improve the preparation method of high purity La, the following methods were investigated for the separation of lanthanides such as Ce, Pr, Nd, Sm, Eu, Tb and Y in ammonium lanthanum nitrate: the behavior of the rare earth elements during the fractional crystallization of ammonium lanthanum nitrate and the elimination of Ce by the conversion of the valence. It was found that when the content of Ce in La is more than 1%, good results were obtained by standing the solution for over a week, but when the content of Ce is less than 0.1% the result was poor. If ferric ion as scavenger was added to the solution, satisfactory results were obtained. For instance, cerium content originally presented in amounts ranging 0.002 to 1.0% was reduced from twentieth to hundredth. (Japan)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstract 14617.

14546 SURFACE TENSION OF PURE LIQUID COMPOUNDS. Jasper, J. J. (Wayne State Univ., Detroit). J. Phys. Chem. Ref. Data; 1: No. 4, 841-1009(1972).

The surface tension tables presented herein are the result of a literature survey, evaluation, and compilation of data of some 2200 pure liquid compounds, 226 of which were reported for a single temperature. These are arranged with related compounds in the increasing order of their molecular weights. As far as possible the method of measurement, nature of atmosphere to which the liquid was exposed during measurements, and the estimated accuracy are given for each liquid. The tabulated values were calculated from the derived results of directly measured quantities reported in the literature of many countries from about 1874 to 1969. Preliminary plots of the experimentally measured quantities indicated that the surface tensions of the liquid compounds are linear functions of the temperature over the reported operational range. The principle of least squares was applied to experimental surface tension values to establish the regression curves and their equations. The constants of the equations (slope and intercept), together with the standard deviations, are given for each compound. The selection factors establishing criteria of quality of surface tension data are discussed. These include (a) method of measurement, (b) purity of compound, (c) quality of apparatus and assembly, (d) experimental procedure (experimentation), (e) reliability of measurements (most probable values), (f) experience of investigator, and (g) availability of data. There are 274 references listed alphabetically. (auth)

Isotope Effects

Refer also to abstracts 14605 and 14607.

14547 MECHANISM OF ACTION OF STREPTOCOCCAL PROTEINASE. III. THE EFFECT OF pH, ORGANIC SOLVENTS, AND DEUTERIUM OXIDE ON THE PROTEINASE-CATALYZED HYDROLYSIS OF N-ACYLAMINO ACID ESTERS. Kortt, A. A.; Liu, T. Y. (Brookhaven National Lab., Upton, NY). Biochemistry; 12: No. 2, 338-345(16 Jan 1973).

The pH dependence of proteinase-catalyzed hydrolysis of p-nitrophenyl and phenyl N-Z-L-alaninate and of phenyl α-N-Z-L-lysinate was determined. The pH-k_{cat} profile was sigmoidal, which is consistent with the supposition that for specific ester substrates k_{cat} is a measure of k_3, the deacylation rate constant, and indicates that deacylation is dependent on a basic group of pK = 4.1. The pH-k_{cat}/K_m profiles were also found to be dependent on a single ionizable basic group of pK = 4.44. The effect of deuterium oxide on the proteinase-catalyzed hydrolysis of several ester substrates was determined. A deuterium oxide isotope effect (k^{H_2O}/k^{D_2O}) of 2 to 3 was found and this was attributed to the involvement of a proton transfer in the rate-determining step (deacylation) of proteinase hydrolysis. A similar deuterium oxide isotope effect was noted for papain. (MCG)

14548 ISOTOPE EFFECT IN PHOTODISSOCIATION PROCESSES OF TRIPLET EXCITED MOLECULES. Plotnikov, V. G.; Kozlov, Yu. I.; Smirnov, V. A.; Alfimov, M. V.; Gebel, V. M. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 4, 367-70(Apr 1972).

Translated from Opt. Spektrosk.; 32: No. 4, 694-701(Apr 1972).

It is shown that the photodissociation of the triphenylmethane molecule, with breaking of the central C–H (C–D) bond, occurring in highly excited triplet states, is characterized by a strong isotope effect. The experimentally determined ratio of the rate constants for breaking the Ph_3C-H and Ph_3C-D bonds in a nonpolar matrix is ~5. This effect is interpreted on the basis of a predissociation mechanism of decomposition. The effect of delocalization of the unpaired electron in the radical being formed on the probability of formation of the latter is discussed. The impossibility of describing this reaction within the framework of the quasi-equilibrium theory is demonstrated. (auth)

14549 HYDROLYSIS OF D-GLUCONO-δ-LACTONE. I. GENERAL ACID–BASE CATALYSIS, SOLVENT DEUTERIUM ISOTOPE EFFECTS, AND TRANSITION STATE CHARACTERIZATION. Pocker, Y.; Green, Edmond (Univ. of Washington, Seattle). J. Amer. Chem. Soc.; 95: No. 1, 113-119(10 Jan 1973).

Polarimetric and spectrophotometric methods were used to study the hydrolysis of D-glucono-δ-lactone over a wide range of pH values at 25.0°. The reaction has been found to exhibit both general acid and general base catalysis. Catalytic coefficients for hydronium ion and malonic, formic, and acetic acids conform to the Brønsted relation with an exponent $\alpha = 0.42 \pm 0.02$. General acid catalysis by dihydrogen phosphate monoanion is ca. 50-fold larger than that ascribable to it from the pK_a of $H_2PO_4^-$. Catalytic coefficients for water, malonate monoanion, formate, acetate, imidazole, monohydrogen phosphate, and Tris conform to the Brønsted relation with an exponent $\beta = 0.45 \pm 0.02$. Hy-

droxide ion shows a positive deviation of ca. two log units from this line. In the water-catalyzed hydrolysis, the solvent isotope effect k_{H_2O}/k_{D_2O} has a value of 3.9. The solvent deuterium isotope effects associated with a number of general acids and bases are also shown to be quite similar to those observed in the hydration of acetaldehyde and in the mutarotation of glucose. Further transition state characterization follows from the absence of oxygen exchange during the hydrolysis of D-glucono-δ-lactone. (auth)

14550 STEREOCHEMISTRY OF THE NONCATALYTIC ADDITION OF MOLECULAR DEUTERIUM TO CYCLOPENTADIENE. Anet, F. A. L.; Leyendecker, Francois (Univ. of California, Los Angeles). J. Amer. Chem. Soc.; 95: No. 1, 156-159(10 Jan 1973).

The noncatalytic reaction of deuterium gas with cyclopentadiene at 300°C is found by NMR spectroscopy to give both cis-3,5-dideuteriocyclopentene and undeuterated cyclopentene. With deuterons and olefinic protons decoupled, the proton spectrum of cis-3,5-dideuteriocyclopentene is analyzed as an A_2BC system where the A protons are on C_3 and C_5 and the BC protons are on C_4. The following parameters are obtained: δ_A = 2.282 ppM, δ_B = 1.797 ppM, δ_C = 1.808 ppM, J_{AB}(trans) = 5.63 Hz, J_{AC}(cis) = 9.46, J_{BC}(gem) = −12.74 Hz. The difference (0.012 ± 0.002 ppM) between δ_B and δ_C represents a real stereochemical isotope-effect chemical shift. The formation of undeuterated cyclopentene is ascribed to a concerted Woodward–Hoffmann allowed suprafacial transfer of two hydrogen atoms from cis-3,5-dideuteriocyclopentadiene. The stereochemistry of the deuterated cyclopentene is in agreement with a concerted suprafacial 1,4 addition of molecular deuterium to cyclopentadiene. (auth)

14551 NUCLEAR MAGNETIC RELAXATION RATES OF 205Tl(I) IN AQUEOUS SOLUTION WITH RESPECT TO COMPLEXING OF MOLECULAR OXYGEN. Bacon, M.; Reeves, L. W. (Univ. of Waterloo, Ont.). J. Amer. Chem. Soc.; 95: No. 1, 272-273(10 Jan 1973).

Results of a study of $^{205}Tl(I)$ nuclear spin relaxation for the aqueous ion show that no dependence of R_1 on the Tl(I) concentration is observed between 0.03 and 3.5 M and furthermore, the anion dependence of R_1 is also negligible for the ions acetate, fluoride, sulfate, and nitrate. The most striking feature of the data is the sensitivity of R_1 and R_2 to dissolved oxygen, which at atmospheric partial pressure has a solubility of 4.8×10^{-6} mole fraction in pure water at 25°C. It was found that the ratios for $R_1(D_2O)/R_1(H_2O)$ are the same as the ratios of the macroscopic viscosities of pure D_2O and H_2O at 25°C. This infers that the relaxation mechanisms are the same in H_2O and D_2O. (DHM)

14552 BOND ENERGY ORDERING BY ISOTOPE EFFECTS AND THE STRUCTURE OF SUBSTITUTED 2-BROMOETHYL RADICALS. Lewis, E. S.; Kozuka, S. (Rice Univ., Houston, TX). J. Amer. Chem. Soc.; 95: No. 1, 282-283(10 Jan 1973).

The tritium isotope effects are reported for the radical addition of HBr to $RCH = CH_2$, where R is p-tolyl, phenyl, p-chlorophenyl, tert-butyl, Br, or H. (DHM)

14553 CATALYSIS IN WATER POOLS. Menger, F. M.; Donohue, J. A.; Williams, R. F. (Emory Univ., Atlanta). J. Amer. Chem. Soc.; 95: No. 1, 286-288(10 Jan 1973).

A mechanistic study is reported of an imidazole-catalyzed ester hydrolysis occurring within micellar water. Only a small isotope effect was observed when deuterium oxide was substituted for water (k_{H_2O}/k_{D_2O} = 1.10). (DHM)

14554 MICROWAVE SPECTRA OF MOLECULES OF ASTROPHYSICAL INTEREST. I. Formaldehyde, Formamide, and Thioformaldehyde. Johnson, D. R.; Lovas, F. J.; Kirchhoff, W. H. (National Bureau of Standards, Washington, DC). J. Phys. Chem. Ref. Data; 1: No. 4, 1011-1045(1972).

The available data on the microwave spectra of formaldehyde, formamide, and thioformaldehyde are critically reviewed for information applicable to radio astronomy. Molecular data such as rotational constants, centrifugal distortion parameters, dipole moments, hyperfine coupling constants, and structural parameters are tabulated. Observed rotational transitions are presented for the astronomically interesting isotopic forms of these molecules when available. Detailed centrifugal distortion calculations were carried out for the most abundant isotopic forms of these molecules, namely, $H_2{}^{12}C^{16}O$, $H_2{}^{13}C^{16}O$, $^{14}NH_2{}^{12}CH^{16}O$, and $H_2{}^{12}C^{32}S$. Transitions were predicted and tabulated for the frequency ranges: 1 MHz to 300 GHz for $H_2{}^{12}C^{16}O$, 100 MHz to 300 GHz for $H_2{}^{13}C^{16}O$, 500 MHz to 180 GHz for $^{14}NH_2{}^{12}CH^{16}O$, and 100 MHz to 300 GHz for $H_2{}^{12}C^{32}S$. All predicted transitions include 95 percent confidence limits; measured transition error limits have been reproduced from the original literature. References are given for all data included. (auth)

14555 KINETIC ISOTOPE EFFECTS IN THE DEHYDROFLUORINATION OF CHEMICALLY ACTIVATED 1,1,1-TRIFLUOROETHANE. Neely, B. D.; Carmichael, H. (North Carolina State Univ., Raleigh). J. Phys. Chem.; 77: No. 3, 307-313(1 Feb 1973).

Hexafluoroacetone was cophotolyzed with acetone and with acetone-d_6, and the rate of the unimolecular dehydrofluorination of the 1,1,1-trifluoroethanes formed from combination of CF_3 and CH_3 or CD_3 radicals was determined from the difluoroethene/trifluoroethane ratio. This ratio was found to depend on the extent of conversion because of secondary reactions. Extrapolations to zero conversion corrected for this effect. The measured kinetic isotope effect was found to be 2.84 ± 0.07. Values of the isotope effect and rate constants predicted by applying RRKM theory to two different models of the activated complex show that both models predict results similar to observations. (auth)

14556 VIBRATION-TO-ROTATION ENERGY TRANSFER IN WATER, HEAVY WATER, AND AMMONIA. Shin, H. K. (Univ. of Nevada, Reno). J. Phys. Chem.; 77: No. 3, 346-351(1 Feb 1973).

Vibrational deexcitation in H_2O-H_2O, D_2O-D_2O, and NH_3-NH_3 in the temperature range 300 to 2000°K was investigated on the basis of a vibration-to-rotation energy transfer mechanism. The deexcitation collision number for NH_3 is very small and changes slowly with temperature; it changes from 13 at 300°K to 5 at 2000°K. This result is in good agreement with ultrasonic absorption measurements over 300 to 773°K. For H_2O, the collision number is significantly larger: 197 at 300°K and 46 at 2000°K. The deexcitation is much less efficient in D_2O compared to H_2O, particularly at low temperatures: at 300°K it is 594 and decreases to 49 at 2000°K. D_2O rotates slower than H_2O, and is not as efficient as H_2O in deexciting the collision partner. In all collisions, the participation of translational motion as well as the effect of molecular attraction is explicitly considered. The model of vibration-to-translation energy transfer taking place at preferred dipole–dipole orientations lead to collision numbers which are seriously different from the above result; such energy transfer is not important in these systems. However, for SO_2-SO_2, the calculation indicates that the latter model is acceptable. (auth)

14557 DEUTERIUM ISOTOPE EFFECT IN ENZYMATIC TRANSAMINATION OF L-DEUTERIO-PHENYLALANINE TO DEUTERIO-PHENYLPYRUVIC ACID. Rhodes, H. J.; Kluza, R. B.; Blake, M. I. (Univ. of Illinois, Chicago). J. Pharm. Sci.; 62: No. 1, 59-64(Jan 1973).

L-Deuterio-phenylalanine was isolated by gradient elution ion-exchange chromatography of the ionic fraction obtained from the cell wall hydrolysate of algae grown in culture medium containing 99.6% deuterium oxide. The enzyme system present in rat brain extract was used for determining the rate of transamination of L-deuterio-phenylalanine and its protio analog. The phenylpyruvate formed was determined spectrophotometrically at 300 nm. using the arsenate-catalyzed enol–borate assay procedure. Transamination rates were determined in media containing varying concentrations of amino acid and α-ketoglutarate. Kinetic determination of maximum velocity was conducted through graphical analysis of the data. The deuterium isotope effect, expressed as the V_H/V_D value, was 1.64. (auth)

14558 SOME FORMS OF THE ISOTOPE EFFECTS OBSERVED IN THE MASS SPECTRA. Constantin, Emilia (Babes-Bolyai Univ., Cluj). Stud. Cercet. Fiz.; 24: No. 6, 753-63(1972). (In Rumanian).

Topics discussed include the isotope effect in the total ion current; isotope fragmentation effects; in fast fragmentation, in metastable transitions and in rearrangements; and theoretical treatment of the fragmentation isotope effects. (auth)

Isotope Exchange and Isotope Separation

Refer also to abstract 14621.

14559 (AD-746135) CONCENTRATION OF BROMIDE IONS IN SEAWATER BY ISOTOPIC EXCHANGE WITH MERCUROUS BROMIDE. Final Report. Foti, S. C. (Naval Ordnance Lab., White Oak, Md.). 6 Jun 1972. 15p. (NOLTR-72-132). NTIS.

In a previous study it was reported that silver bromide can concentrate the radioactive bromide ions in seawater by a process of isotopic exchange. Mercurous bromide looked more favorable because of its lower solubility and lower cost and it was thus used to determine its effectiveness relative to silver bromide, in concentrating bromide ions from seawater. The effect of the height of the mercurous bed, flow rate and volume (residence time) of the seawater on the amount of bromide ions exchanged was studied. Each of the variables was found to have a significant effect. The results indicated that under the same conditions mercurous bromide can

concentrate the bromide ion in seawater slightly more than the silver bromide. (auth)

14560 (COO-3263-2) SEPARATION OF ISOTOPES. Annual Progress Report. Ghate, M. R.; Choi, C. H.; Taylor, T. I. (Columbia Univ., New York. Dept. of Chemistry). 1 Nov 1972. Contract AT(11-1)-3263. 80p. Dep. NTIS.

The chemical exchange reaction between carbon dioxide (CO_2) and the carbamate of di-n-butylamine (R_2NCOO^{-+} HNR_2) in triethylamine as solvent results in a concentration of ^{13}C in the liquid phase and ^{18}O in the gas phase. A solvent carrier system with thermal reflux for stripping the carbon dioxide from the carbamate is used to test the effectiveness of this and other amine-solvent systems. Results on the operational characteristics of a cascade of six 2.5 meter columns for the preparation of high concentrations of ^{13}C are reported. Measurements of single stage separation factors (α) for different amine-carbamate systems by batch and multistage techniques are being continued. Preliminary results indicate that α is nearer 1.006 than 1.01 assumed previously. Correlations are being made between the effectiveness of amines for the separation of ^{13}C and their structure, reaction rates and thermodynamic properties as well as the physical characteristics of their solutions. (auth)

14561 (MLM-1910(TR)) OVER THE ENRICHMENT OF THE STABLE ISOTOPE ^{34}S IN THE SYSTEM HYDROGEN SULFITE/SULFUR DIOXIDE. PART ONE: THE SYSTEM HYDROGEN BISULFITE/SULFUR DIOXIDE. Stiehl, G.; Mueehle, K. Translated for Mound Lab., Miamisburg, Ohio, from Isotopenpraxis; 5: 326-28(1969). 9p. Dep. NTIS.

The composition of the solution and the pH value of the system $NaHSO_3-SO_2$ were investigated, dependent on the $NaHSO_3$ concentration. The dependence of the overall separation factor for the enrichment of ^{34}S on the $NaHSO_3$ concentration, temperature, and flow rate was determined experimentally. The single stage factor for 3 M $NaHSO_3$ was found to be $\alpha = 1.007$. (auth)

14562 RECENT DEVELOPMENTS IN CATALYTIC THEORIES: ISOTOPIC HYDROGEN EXCHANGE CATALYSED BY METALS. Garnett, J. L. (Univ. of New South Wales, Kensington, Australia). Proc. Roy. Aust. Chem. Inst.; 39: No. 10, 293-7(Oct 1972).

Recent trends in theories relating to bonding at metallic surfaces, particularly the relationships between homogeneous and heterogeneous catalysis, are discussed with particular reference to isotopic hydrogen exchange. (Australia)

14563 NUCLEOPHILIC SUBSTITUTION REACTIONS INVOLVING SULFENIC ACIDS AND SULFENYL DERIVATIVES. THE NUCLEOPHILE- AND ACID-CATALYZED ^{18}O EXCHANGE OF PHENYL BENZENETHIOSULFINATE. Kice, J. L.; Cleveland, J. P. (Oregon State Univ., Corvallis). J. Amer. Chem. Soc.; 95: No. 1, 104-109(10 Jan 1973).

The acid- and nucleophile-catalyzed ^{18}O exchange of phenyl benzenethiolsulfinate-^{18}O was studied in 60% dioxane using n-butyl sulfide, bromide ion, and chloride ion as the nucleophilic catalysts. Comparison of the rates for the exchange with the rates for the acid- and nucleophile-catalyzed racemization of (+)-PhS-(O)SPh under the same conditions shows that benzenesulfenic acid (PhSOH) is orders of magnitude more reactive than water as a nucleophile toward reactive sulfenyl derivatives such as PhSCl, PhSBr, or $PhSS^+R_2$. The rapidity with which PhSOH performs a nucleophilic substitution on such sulfenyl compounds explains why sulfenic acids are never isolated as hydrolysis products of sulfenyl halides and related compounds. The relatively high reactivity of sulfenic acids as nucleophiles in displacements at dicoordinate sulfur would appear to have other significant ramifications for a number of aspects of sulfur chemistry. (auth)

14564 STEREOSPECIFIC RADICAL-CHAIN EXCHANGE OF HYDROGENS. Shea, K. J.; Skell, P. S. (Pennsylvania State Univ., University Park). J. Amer. Chem. Soc.; 95: No. 1, 283-284(10 Jan 1973).

In a study of the photobromination of (+)-1-bromo-2-methylbutane the successful trapping of a dissymetric intermediate with DBr is reported that results in addition of a deuterium to the radical center with >96% retention of the original skeletal configuration. Results show that in radical substitutions of deuterium for hydrogen in (+)-1-bromo-2-methylbutane substitution occurs exclusively at C-2, the sign of rotation is unchanged, and the magnitude of the rotation is very little affected despite the high degree of conversion in a reversible reaction. Other work has shown that k_{HBr} is approximately 50% greater than k_{DBr}. (DHM)

14565 KINETICS OF THE ISOTOPIC EXCHANGE REACTIONS BETWEEN SODIUM IODIDE AND BENZYL IODIDE IN HYDROXYLIC SOLVENTS. Oancea, D.; Podina, C. (Univ., Bucharest). Rev. Roum. Chim.; 17: No. 12, 1937-1949(Dec 1972).

The kinetics of the isotopic exchange reactions between sodium iodide and benzyl iodide in n-propyl and n-butyl alcohols was studied. The results, together with the similar data reported in literature for the same reaction occurring in methyl and ethyl alcohols, are discussed on the basis of both the collision and transition state theories in solution. The rate constant of the isotopic exchange exhibits a maximum in n-propyl alcohol. This result could be explained in view of the compensatory behavior of the enthalpy and entropy of activation. By using different concentrations of sodium iodide, it was found that ionic pairing occurred in these solvents at higher concentrations of ionofore. (auth)

14566 QUANTITATIVE STUDY OF ACTIVE METHYL GROUPS IN C-METHYL-s-TRIAZINES. I. HYDROGEN EXCHANGE KINETICS OF 6-METHYL-s-TRIAZINE-2,4(1H,3H)-DIONE AND ITS N-METHYL DERIVATIVES (STUDIES IN THE s-TRAZINE FIELD. NEW SERIES, VI). Safta, M. (Polytechnic Inst., Timisoara, Rumania); Chiraleu, F.; Balaban, A. T.; Ostrogovich, G. Rev. Roum. Chim.; 17: No. 12, 2055-2065 (Dec 1972).

The $C_{(6)}$-methyl group of 6-methyl-s-triazine-2,4(1H,3H)-dione (1) and of its 1,6-dimethyl-(2) and 1,3,6-trimethyl-derivative (3) undergoes ready deuterium exchange in buffered D_2O solutions. The kinetic parameters were determined by NMR both for the acid-catalyzed (for 1, 2 and 3) and the base-catalyzed reactions (for 3), evidencing the pH dependence of the rate constants. Compounds 1 and 2 are not methyl-deuterated in basic catalysis. 1,3,5,6-Tetramethyl-2,4-(1H,3H)-dione-s-triazinium iodide (4) exchanges the hydrogens too fast to follow kinetically. The pK values of 1 to 3 were determined, and a modified procedure for preparing 2 was described. (auth)

Feed Materials Processing

Refer also to abstract 14636.

14567 (AAEC/E-238) URANIUM PROCESSING. Papers Presented to the AAEC Symposium, Lucas Heights, 20-21 July 1972. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1972. 230p. (CONF-720728).

The papers on various aspects of uranium ore processing and production of UF_6 were presented. Each is given a separate abstract. (Australia)

For abstracts of individual papers see: 14568-14577.

14568 (AAEC/E-238, pp I,1-12) REVIEW OF NUCLEAR FUEL CYCLES AND WORLD TRENDS. Miles, G. L. (Australian Atomic Energy Commission). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

Areas of possible Australian involvement in uranium in the nuclear fuel industry are suggested in the light of trends in demand for and supply of uranium in its various forms. (Australia)

14569 (AAEC/E-238, pp II,1-44) CONVENTIONAL PROCESSES TO PRODUCE YELLOW CAKE. Hartley, F. R. (Australian Mineral Development Labs., Adelaide). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

Ore treatment operations are considered from 2 viewpoints: treatment depending on the mineralogy of the ore (comminution, physical beneficiation, leaching, solid-liquid separation), and uranium extraction operations depending on quantity of uranium and quality of product (IX and SX processes, precipitation and filtration, drying and packing). Reagents and services required for a treatment plant are summarized and costs are briefly considered. (Australia)

14570 (AAEC/E-238, pp III,1-13) CARBONATE LEACHING OF URANIUM ORES: A REVIEW. Butler, R. D. Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

Standard practice in Canada and the U.S.A. in carbonate leaching is reviewed with particular reference to the Canadian Beaverlodge plant. Carbonate leaching could have special significance in the West Australian environment because of its closed-circuit operation. (Australia)

14571 (AAEC/E-238, pp IV,1-24) APPLICATION OF MINERALOGY TO URANIUM ORE PROCESSING. Henley, K. J.; Cooper, R. S.; Kelly, A. (Australian Mineral Development Labs., Adelaide). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

The application of mineralogy to aspects of physical beneficiation and chemical extraction of uranium ores is reviewed under the headings mineral identification, modal analysis, specific mineral properties, liberation and associations, and specific application to Mary Kathleen uranium ore, Valhalla uranium ore and Nabarlek leach residues. (Australia)

14572 (AAEC/E–238, pp V.1-18) EXTRACTION INVESTIGATIONS WITH SOME AUSTRALIAN URANIUM ORES. Goldney, L. H.; Canning, R. G.; Gooden, J. E. A. (Australian Mineral Development Labs., Adelaide). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

Laboratory extraction investigations with Nabarlek, Armchair Creek and Streitberg Ridge, and Valhalla uranium ores are described. All are amenable to acid leaching—Nabarlek is high grade, the 2 Mt. Painter ores are both low-grade (the lower grade of the 2 responds to préconcentration), and Valhalla is low-grade (it is chemically more refractory, the greater part being brannerite). (Australia)

14573 (AAEC/E–238, pp VI.1-13) PLANNED CHANGES IN THE MARY KATHLEEN TREATMENT PLANT FOR FUTURE OPERATIONS. Baillie, M. G.; Thomas, J. A. Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

Proposed process changes and additions for the Mary Kathleen plant are discussed together with flowsheets and operating costs. (Australia)

14574 (AAEC/E–238, pp VII.1-22) POSSIBLE TRENDS AND METHODS FOR THE PRODUCTION OF HIGH-PURITY PRODUCTS. Hardy, C. J. (Australian Atomic Energy Commission). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

A brief review of refining processes for uranium concentrates is given (yellowcake and UF_4). Technical, economic and marketing factors which are considered in the evaluation of the advisability of producing a refined product at a mill are discussed. (Australia)

14575 (AAEC/E–238, pp VIII.1-22) REVIEW OF METHODS AND TECHNOLOGY FOR THE PRODUCTION OF URANIUM HEXAFLUORIDE. Alfredson, P. G. (Australian Atomic Energy Commission). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

The properties of UF_6 and the main flowsheets used industrially for its production are discussed. The processes and the technology of their associated equipment are reviewed and some alternatives having potential for future development are considered. (Australia)

14576 (AAEC/E–238, pp IX.1-32) CAPITAL AND OPERATING COSTS FOR THE PRODUCTION OF URANIUM HEXAFLUORIDE. Costello, J. M. (Australian Atomic Energy Commission). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

Approximate capital investment and unit reprocessing cost for the conversion of uranium ore concentrates to UF_6 would be \$A 13×10^6 and \$A 33×10^6 for 3,000 and 10,000 tonne U/y respectively (excluding supporting industries and other development). Captive HF and H_2SO_4 plants may cost a further \$A $2\text{-}2.5 \times 10^6$. Toll conversion services for costs of \$A 2.91/kg U and \$A 2.53/kg U (3,000 and 10,000 tonne U/y) could be supplied (inclusive of transport charges) for delivery of UF_6 to Oak Ridge enrichment plant. Total cost to a utility purchasing Australian ore concentrate for conversion and delivery to Oak Ridge is estimated at \$A 2.62-3.00/kg U for conversion at an Australian plant, compared with \$A 2.98/kg U for conversion in the USA. (auth)

14577 (AAEC/E–238, pp X.1-15) MARKET FOR AUSTRALIAN CONVERSION SERVICES. Silver, J. M.; Richmond, M. R. (Australian Atomic Energy Commission). Sep 1972.

From AAEC symposium on uranium processing; Lucas Heights, Australia (20 Jul 1972).

Variables affecting the growth of the need for U_3O_8 and its conversion to UF_6 are described (on world-scale). An analysis of the current and expected UF_6 conversion industry is made. (Australia)

14578 (IEA–264) ADSORPTION OF URANIUM CONTAINED IN URANYL NITRATE SOLUTIONS ON STRONG CATIONIC RESIN AND ITS ELUTION WITH AMMONIUM SULFATE. PART III. DECONTAMINATION OF PHOSPHATE. Ribas, A. G. S.; Abrao, A. (Instituto de Energia Atomica, Sao Paulo (Brazil)). Mar 1972. 20p. (In Portuguese). (CONF-710736–1). Dep. NTIS (U. S. Sales Only).

From 23rd annual conference of SBPC; Curitiba, PR (Jul 1971).

Studies were made of the decontamination of phosphorous present as an impurity in uranyl nitrate solutions. They were carried out using strong cationic resins where the phosphorous was partially retained, by means of adsorption or cationic complex formation with the uranyl ion. The behavior of the phosphate ion was studied using $^{32}PO_4^{3-}$, as a function of EDTA/U ratio, acidity, flow rate, and PO_4^{3-} concentration of the influent uranyl nitrate, as well as the scrubbing flow rate. The desorption of PO_4^{3-} was also studied for several different solutions. (auth)

14579 ACCELERATED THICKENING AND FILTRATION OF URANIUM LEACH PULPS FROM THE BAGHALCHORE ORE. Toor, F. D.; Haider, S. (Atomic Energy Centre, Lahore). Nucleus (Karachi); 9: No. 1-2, 61-9(1972).

Five locally available materials were tested as flocculants and two of these are found to favorably affect the thickening and settling characteristics of acid leach pulps of uranium ore available at Baghalchore, District Dera Ghazi Khan, West Pakistan. Optimum concentration and volume of these materials are determined and the effects of variations of ore particle size and pre-treatment, slurry concentration and pH, etc., on the performance of these flocculants are established. (auth)

Radiation Chemistry

14580 (CONF-720847–(Abstr.)) SIXTH AINSE RADIATION CHEMISTRY CONFERENCE, LUCAS HEIGHTS, AUGUST 21–23, 1972. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 42p.

Forty-one papers were presented dealing with chemical radiation effects on organic compounds and solutions. Each paper is in abstract form only. (Australia)

14581 (ORO—3519–12) RADIATION CHEMISTRY OF MONO-SUBSTITUTED AROMATIC COMPOUNDS. Progress Report, January 15, 1972—January 15, 1973. Knight, J. A. Jr. (Georgia Inst. of Tech., Atlanta. Engineering Experiment Station). 1973. Contract AT(40-1)-3519. 8p. Dep. NTIS.

The radiolysis investigation of benzonitrile is currently underway and will be continued with irradiations of pure benzonitrile and benzonitrile plus additives. Authentic samples of 2- and 3-cyanobiphenyl and of the six isomeric dicyanobiphenyls were prepared in the laboratory for identification and calibration purposes. Gas chromatographic conditions for the analysis of irradiated benzonitrile for the dicyanobenzenes, cyanobiphenyls, and the dicyanobiphenyls have been determined. Radiolytic products which have been identified from irradiated benzonitrile are hydrogen, benzene, the dicyanobenzenes, the cyanobiphenyls, and the dicyanobiphenyls. (auth)

14582 (RT/BIO–(72)29) THERMOLUMINESCENCE STUDIES OF X-RAY IRRADIATED OLEIC ACID, GLYCEROL, AND TRIOLEIN. Caserta, G.; Cervigni, T. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1972. 15p. INIS.

The distribution of metastable energy states in oleic acid, glycerol, and their esterification product, triolein, irradiated at low temperature with x rays, is analyzed by means of thermoluminescence measurements. The metastable energy states are interpreted as low temperature electron trapping sites which have a well defined activation energy for electron detrapping. In oleic acid four groups of traps with activation energies equal to 0.068, 0.102, 0.158, and 0.209 eV were disclosed. Glycerol, which displays a very weak light emission, also contains discrete sets of traps up to about 0.1 eV. Triolein, on the contrary, shows an exponential distribution of trapping centers from 0.1 to 1.2 eV. The light spectrum is nearly of the same type for the three substances, and is essentially composed of two wavelengths: 3750 and 4800 Å. The possible role of the double bonds in the luminescence processes is outlined. (auth)

14583 PRELIMINARY OBSERVATIONS ON THE GAMMA AND PULSE RADIOLYSIS OF SELENOCYSTINE. Badiello, R.; Tamba, M. (CNR, Bologna). Stud. Biophys.; 29: 193-7(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The main product from the radiolysis of selenocystine in aqueous solutions is elementary selenium; yields increase linearly with increasing radiation dose up to 4×10^5 rads. Some amino acids that do not contain Se are present. In particular, alanine, which is present in small amounts in argon and in N_2O saturated solutions ($G < 0.1$) is a main product when reducing conditions prevail ($G = 0.24$). On the contrary serine, which is present in trace amounts in argon-saturated solution and is absent when OH radicals are scavenged by methanol, appears in relatively high con-

centration under predominantly oxidizing conditions (G < 0.1). From pulse radiolysis results it appears that both -SeSe- and -SS- linkages are sensitive to free radical attack. (DHM)

14584 COPOLYMERIZATION GRAFTING OF METHYL METHACRYLATE WITH PREVIOUSLY IRRADIATED CELLULOSE. Yunusov, M. Yu.; Azizov, U. A. Uzb. Khim. Zh.; No. 5, 64-6(1971). (In Russian).

The formation of peroxide groups in cellulose upon exposure to ^{60}Co gamma radiation facilitated graft polymerization of methyl methacrylate to the cellulose molecules. The temperature of this grafting process was optimum at 65°C; above and below 65°C the yield of the grafted polymer fell off rapidly. Grafting was also studied as a function of time. The activation energy of +14.3 kcal/mole suggested a radical mechanism in the grafting process. With increased amounts of grafted methyl methacrylate the potential of cellulose for sorbing water vapor steadily decreased. (KSW)

14585 RADIATION VAPOR-PHASE GRAFTING OF VINYL FLUORIDE TO CAPRONE FIBER. Yul'chibaeva, S. G.; Rakhimova, N.; Urunova, R.; Usmanov, Kh. U. (Tashkent State Univ.). Uzb. Khim. Zh.; No. 5, 75-6(1971). (In Russian).

Sealed ampules containing a Caprone fiber and vinyl fluoride monomer (not in contact with each other) were given doses of ^{60}Co radiation ranging from 0.25 to 6.05 MR. Increased irradiation times increased the amount of vapor phase grafting to the fiber. An investigation of the effect of H_2O, alcohol, and dimethylformamide vapors on the grafting process showed that water and dimethylformamide facilitated grafting. (KSW)

14586 REACTIONS OF CYANOGEN RADICALS. Pt. 2. REACTIONS WITH $(CN)_2$ AND O_2. Bullock, G. E.; Cooper, R. (Melbourne Univ., Parkville, Australia). J. Chem. Soc., Faraday Trans., I; 68: No. 12, 2175-84(1972).

The gas phase reactions of CN radicals with $(CN)_2$ and O_2 were studied as a function of temperature and vibrational excitation of the CN. The first reaction has $E_{act} \simeq 13.1$ kJ mol^{-1} and only inefficient vibration → translational transfer occurred with the excited CN levels. The reaction with O_2 has no activation energy, but the rate constants increase with CN vibrational level. NCO radicals were produced more rapidly than CN($X^2\Sigma$ electronic ground state; 0, 0 vibrational band) radicals were removed, indicating that vibrational excitation may contribute to the overall kinetics of this system. (auth)

14587 REACTIONS OF CYANOGEN RADICALS. Pt. 3. ARRHENIUS PARAMETERS FOR REACTIONS WITH ALKANES. Bullock, G. E.; Cooper, R. (Melbourne Univ., Parkville, Australia). J. Chem. Soc., Faraday Trans., I; 68: No. 12, 2185-90(1972).

Using the technique of gas phase pulse radiolysis, the Arrhenius parameters for the reactions of CN radicals with methane and ethane were determined. With methane there is an activation energy of 8.36 ± 0.5 kJ mol^{-1} whereas for the reaction with ethane the value is 0(<800) J mol^{-1}. Also reported are the rate constants at 300°K for reaction with CD_4 and propane. The effect of vibrational excitation of the CN radicals on the apparent rate constants is discussed. (auth)

14588 RADIOLYSIS OF AQUEOUS SOLUTIONS OF NUCLEIC ACID FRAGMENTS. REACTIONS OF PYRIMIDYL RADICALS WITH ALCOHOL. Fel, N. S.; Zaozerskaya, L. A.; Dolin, P. I. (Inst. of Electrochemistry, Moscow). Radiat. Eff.; 15: No. 1-2, 57-9(Jul 1972).

Using a steady state concentration method the rate constants were measured for the reactions of radicals, formed upon addition of OH and e^-_{aq} to thymine with methanol. It was found that $K = (0.8 \pm 0.2) \times 10^4$ M^{-1} sec^{-1} and $K > 2.3 \times 10^3$ M^{-1} sec^{-1} respectively. (auth)

14589 TRANSIENT PHOTOBLEACHING OF TRAPPED ELECTRONS. May, R.; Walker, D. C. (Univ. of British Columbia, Vancouver). J. Chem. Soc., Chem. Commun.; No. 19, 1064 (11 Oct 1972).

Trapped electrons were produced by γ-irradiation of pure KI, KBr, MTHF, and NaOH–KOH glasses, and intense light pulses from a ruby laser were used to saturate trapped electron absorptions in the crystals (viz. KBr and KI) and low temperature glasses (viz. aqueous 10 M OH^- and MTHF). It was shown that the electron band is broadened homogeneously in the crystals and heterogeneously in the MTHF glasses, and the characteristics of transient and permanent photo-bleaching differ very markedly in each system. (auth)

14590 E,S,R. STUDY OF IRRADIATED DIPOTASSIUM DL-MALATE DIHYDRATE. Whelan, D. J. (Defence Standards Labs., Ascot Vale, Australia). Aust. J. Chem.; 25: No. 11, 2507-10(Nov 1972).

The g-tensor and proton hyperfine splitting tensors for the radical $R'CH_2\dot{C}(OH)R$ (R and R' = CO_2H or CO_2^-) trapped in γ irradiated single crystals of potassium DL-malate dihydrate are analyzed in detail. (Australia)

14591 γ-RADIOLYSIS OF CHLORANIL IN BENZENE. Wilson, J. G. (Australian Atomic Energy Commission, Sutherland). Aust. J. Chem.; 25: No. 11, 2383-91(Nov 1972).

γ-Radiolysis of chloranil in benzene gave four products: the quinones 3,6-dichloro-2,5-diphenyl-1,4-benzoquinone and 2-chloro-3,5,6-triphenyl-1,4-benzoquinone, and small amounts of 2,3,5-trichloro-6-phenylhydroquinone and 1,3,4-trichloro-2-hydroxydibenzofuran. The last compound only was formed when radiolysis was carried out in the presence of oxygen. Syntheses of 2,3,5-trichloro-6-phenylhydroquinone, 2,3,5-trichloro-6-phenyl-1,4-benzoquinone, and 2-chloro-3,5,6-triphenyl-1,4-benzoquinone are described. (auth)

14592 CHEMICAL EFFECTS OF IONIZING RADIATION. Guesten, H. (Kernforschungszentrum, Karlsruhe, Ger.). Chem.-Ztg., Chem. App.; 96: No. 5, 279-86(1972). (In German).

The chemical effects induced by ionizing radiation are outlined. The role of electrons, ions, and electronically excited states as the primary species of the action of ionizing radiation with matter are discussed in context with a basic radiation chemical model. The radiolysis of water is taken to demonstrate the radical reactions and the product formation induced by the primary species of radiolysis. Current applications and possible developments of ionizing radiation for commercial processes with special regard to polymers are briefly outlined. (Germany)

14593 γ-RADIOLYSIS OF S-(CIS-PROP-1-ENYL)-L-CYSTEINE IN AQUEOUS SOLUTION. A NEW CIS-TRANS-ISOMERIZATION OF THE PROP-1-ENYL THIYL RADICALS. Nishimura, H.; Mizutani, J. (Hokkaido Univ., Sapporo). J. Chem. Soc., Chem. Commun.; No. 12, 738-9(21 Jun 1972).

The cis- and trans-products from γ-irradiated S-(cis-prop-1-enyl)-L-cysteine were identified and a new isomerization mechanism of the prop-1-enyl thiyl radicals is suggested. (auth)

14594 γ-IRRADIATION OF POLYSTYRENE EMULSIONS. Rudin, A.; Chau, T. C. (Univ. of Waterloo, Ont.). Polym. Chem. Ed.; 10: No. 12, 3589-3603(Dec 1972).

Aqueous polystyrene emulsions were subjected to γ-irradiation at 30°C and 0.6 Mrad/hr dose rate. Analogy with water-soluble systems suggests that such conditions might suppress chain scission and favor crosslinking. The (extrapolated) infinite-dose gel content and gel-permeation analysis of the polymer in the pre-gel region indicate that the extent of chain scission was negligible. The G (crosslink) value obtained from the dose for incipient gelation and molecular weight variations in the pre-gel region is 0.051. Charlesby–Pinner plots were linear, but linearity cannot be construed as indicating that chain scission has produced an effective random molecular weight distribution. Our results are consistent with the conclusions that crosslinking events are random and directly proportional to dose. The probability that a given crosslink is effective in increasing the gel content decreases with dose past the incipient gel point, however, because of cyclization on preformed gel. The crosslink density/dose ratio is a decreasing function of dose in this range. Attempts to predict dose–gel relations with assumptions of various initial molecular weight distributions were unsuccessful, possibly because of the neglected influence of cyclization on the measured gel content. (auth)

14595 RADIATION INDUCED GRAFTING OF ACRYLIC ACID AND METHACRYLIC ACID ON TO POLYESTER (TERYLENE) FIBERS. Rao, K. N.; Rao, M. H.; Moorthy, P. N.; Charlesby, A. (Bhabha Atomic Research Centre, Bombay). Polym. Chem. Ed.; 10: No. 12, 893-896(Dec 1972).

Good H-atom and OH-radical scavengers were chosen as retarding agents in the radioinduced grafting of acrylic and methacrylic acids on polyester fibers to retard homopolymerization. Irradiations were carried out in a γ cell at a dose rate of 0.3 Mrads/hr. It was found that the initiating species in homopolymerization is the H atom adduct of the monomer. (MCG)

14596 THERMAL ANALYSIS OF IRRADIATED POLY(VINYL CHLORIDE). Salovey, R.; Badger, R. G. (Hooker Chemical Corp., Niagara Falls, NY). J. Appl. Polym. Sci.; 16: No. 12, 3265-3274(Dec 1972).

The thermal decomposition and resultant disposal of waste poly(vinyl chloride) (PVC) are facilitated by preliminary exposure to ionizing radiation, such as energetic electrons, in an oxygen atmosphere. The results of isothermal and temperature-programmed thermogravimetry, differential thermal analysis, and effluent gas analysis in nitrogen and in oxygen indicate that the

major effect of irradiation is to render PVC increasingly susceptible to oxidation. The presence of oxygen during heating enhances the decomposition. Crystalline order in PVC is destroyed by irradiation. (auth)

14597 POLYMERIZATION OF 1,2-EPOXY-3-BUTENE AND ITS GRAFT COPOLYMERIZATION TO POLYETHYLENE BY γ-IRRADIATION. Murata, K. (Government Industrial Research Inst., Osaka). Polym. Chem. Ed.; 10: No. 12, 3673-3677(Dec 1972).

Polymerization of 1,2-epoxy-3-butene and the grafting of this compound to Yukalon film were carried out using γ radiation. The polymerizations took place in glass ampoules sealed under nitrogen atmosphere. It was concluded that the polymer consists mainly of a polyether structure having pendant vinyl groups and partly has α,β-unsaturated ketone structure. (MCG)

14598 RADIOLYTIC YIELDS OF HYDRATED ELECTRONS AT 30 TO 1000 PICOSECONDS AFTER ENERGY ABSORPTION. Hunt, J. W. (Univ. of Toronto); Wolff, R. K.; Bronskill, M. J.; (and others) J. Phys. Chem.; 77: No. 3, 425-426(1 Feb 1973).

The $G(e^-_{aq})$ was measured by two entirely different techniques at times shorter than 1 nsec and at 30 psec and a value of 4.0 ± 0.2 was obtained. A stroboscopic pulse radiolysis technique (SPR) was used that observes the kinetics of e^-_{aq} between the linac fine structure pulses spaced at 350-psec intervals. The second technique involves the measurement for times less than 1 nsec using a sampling oscilloscope(SO) with a rise time of 25 psec. The yield after 30 psec (SPR) and before 1 nsec (SO) can both be called initial yields since there is very little observable decay of e^-_{aq} between 30 and 1000 psec. (DHM)

14599 RADIATSIONNOE OKISLENIE ORGANICHESKIKH VESHCHESTV. (Radiation Oxidation of Organic Substances). Romantsev, M. F.; Larin, V. A. Moscow; Atomizdat (1972). 160p.

Primary and secondary elemental radiochemical processes, excited states of molecules, secondary electrons, and the interaction of active particles with oxygen are reviewed. Successive chapters focus attention on the radiation oxidation of hydrocarbons, aliphatic alcohols and ethers, carbonyl compounds, fatty acids and esters, organic compounds containing halogens, sulfur, or nitrogen, and polymers. The practical application of radiation oxidation processes is presented: radiochemical synthesis and modifying the properties of a given system. (347 references) (KSW)

14600 CHEMICAL BONDING EFFECTS OF SILICON AND SILICON DIOXIDES AS OBSERVED IN K X-RAY EMISSION. Moore, C. F.; McWherter, J.; Olsen, D. K.; Richard, P. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 5: No. 13, 873-6(25 Nov 1972).

Alpha and proton beams were used to excite x rays in silicon and silicon oxides. Chemical bonding effects were not clear because inner-shell electrons normally shield the valence electrons such that the K x-ray transitions differ by small amounts no matter what the chemical bonding may, in effect, be. (MCG)

14601 NATURE AND PROPERTIES OF PRIMARY PRODUCTS OF LOW-TEMPERATURE RADIOLYSIS OF CRYSTALLINE ALKALI HYDRATES. Puntezhis, S. A.; Ershov, B. G.; Pikaev, A. K. (Inst. Physical Chemistry, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 10, 2166-2170(Oct 1972). (In Russian).

The primary products of irradiation of various hydrates of LiOH, KOH, NaOD, and NaOh with ^{60}Co gamma rays at 77 and 195°K were studied with EPR and optical spectra. The λ_{max} of the absorption band depended on the nature of the cation, the number of molecules of water in the crystalline hydrate and its isotopic composition. The g-factors of the EPR signal of the ion-radical O^- in the irradiated $NaOH \cdot 3.5\ H_2O$ at 77°K depended strongly on its orientation in the magnetic field, and the results are compared with those of $NaOD \cdot 3.5\ H_2O$. The optical density of $NaOH \cdot 3.5\ H_2O$ at 490 nm was studied as a function of the dose of γ-radiation at 77°K; the optical density reached a maximum at 8×10^{20} eV/g then continued to decrease steadily as the dose was gradually increased to 6×10^{21} eV/g. (KSW)

14602 REACTION OF HYDRATED ELECTRONS WITH FERRICYTOCHROME C. Lichtin, N. N.; Shafferman, A.; Stein, G. (Hebrew Univ., Jerusalem). Science; 179: No. 4074, 680-682 (16 Feb 1973).

The reaction of ferricytochrome c with hydrated electrons produced at pH 6.8 by radiolysis with electron pulses lasting 50 to 1000 nanoseconds has a specific rate constant of 5.5×10^{10} liter $mole^{-1}$ sec^{-1} for the formation of the primary adduct. By using appropriate wavelengths, another fast, consecutive process was demonstrated, with the pure first order rate constant 1.0×10^5 sec^{-1}. Its characteristics agree with it being an intramolecular process within the enzyme. Approximately 50 percent of all electrons which add to ferricytochrome c end in forming ferrocytochrome c. (auth)

14603 PRELIMINARY STUDY OF THERMOLUMINESCENCE IN POLYPROPYLENE. Boustead, I. (Open Univ., Bletchley, Eng.); George, T. J. Polym. Phys. Ed.; 10: No. 10, 2101-2105 (Oct 1972).

Samples of isotactic polypropylene were cooled to 77°K and irradiated in a ^{60}Co γ source. Immediately following irradiation, all samples exhibited a gradually decaying isothermal emission at 77°K, referred to as the preglow. During subsequent warming, all samples gave rise to a glow curve. A second cooling and irradiation enhanced emission intensity and the appearance of an additional component with a peak maximum at ~125°K. Repeated irradiations caused no further changes in the glow curves. (MCG)

14604 DIELECTRIC ABSORPTION OF POLYOXYMETHYLENE OBTAINED FROM THREE CRYSTALLINE CYCLIC FORMALDEHYDE OLIGOMERS BY RADIATION-INDUCED POLYMERIZATION. Tanaka, Akira; Uemura, Shinsaku; Ishida, Yoichi (Osaka Univ.). J. Polym. Sci., Polym. Phys. Ed.; 10: No. 10, 2093-6(Oct 1972).

Crystals of trioxymethylene and pentaoxymethylene were polymerized using γ radiation. Dielectric absorption in the polymers was ascribed to the response of terminal OH groups localized in the defect regions. (MCG)

Radiochemistry and Nuclear Chemistry

Refer also to abstract 16395.

Hot-Atom Chemistry

14605 (COO-2190-2) ISOTOPE EFFECTS IN HOT HALOGEN ATOM REACTIONS. Spicer, L. D. (Utah Univ., Salt Lake City. Dept. of Chemistry). [nd]. 18p. (CONF-720667-1). Dep. NTIS.

From Gordon conference on physics and chemistry of isotopes; Plymouth, NH (26 Jun 1972).

Deuterium isotope effects of a reactive nature were found to be quite pronounced in recoil halogen atom reactions just as they are in tritium atom reactions. Simple classical ideas did not appear to account for the magnitude of the effects. (MCG)

14606 (NRCN-307) REPORT ON THE ACTIVITY OF THE LABORATORY FOR LABELLED COMPOUNDS, SEPTEMBER 1969-October 1970: RADIOCHEMISTRY DEPARTMENT. Buchman, O. (ed.) (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev). Mar 1972. 53p. (In Hebrew). INIS.

A description of a new general method for labelling organic compounds with tritium was developed. The compounds prepared are listed. An alphabetical list of synthetically labelled compounds is then given. It includes the labelling and syntheses procedures, purifying ways and their results. (auth)

14607 DEUTERIUM ISOTOPE EFFECT IN HALOGEN ATOM REACTIONS WITH METHANE AND PERDEUTERIOMETHANE AT ENERGIES ABOVE THERMAL THRESHOLDS. Spicer, L. D. (Univ. of Utah, Salt Lake City). J. Amer. Chem. Soc.; 95: No. 1, 51-53(10 Jan 1973).

The origin of the isotope effect in the reaction of recoil chlorine atoms with methane and perdeuteriomethane was determined by diluting the systems with inert moderator to establish a unique steady-state collision distribution. The ratio of product yields from the hydrogenated system to those from the deuterated system as a function of moderator suggests that the isotope effect is primarily reactive in nature. The average probability of forming CH_3Cl upon collision compared with CD_3Cl is about 1.8 and that of forming CH_2Cl compared with CD_2Cl is about 1.6 in their respective systems. (auth)

14608 CHEMICAL EFFECTS ACCOMPANYING THE ISOMERIC TRANSITION $^{130m}I \rightarrow {}^{130}I$ IN GASEOUS MIXTURES OF IODINE AND BUTANE. Ernstberger, R.; Kuhry, J. G.; Heitz, C. (Univ. Louis Pasteur, Strasbourg). Radiochem. Radioanal. Lett.; 12: No. 6, 345-351(31 Dec 1972). (In French).

The organic yields of ^{130}I resulting from the isomeric transition $^{130m}I \rightarrow {}^{130}I$ in gaseous butane were measured as a function of the mole fraction of iodine and of rare gases (Ar, Kr, Xe). The formation of the organic iodides involves hot reaction (1.1%), ion-molecule reactions (0.59%) and radiolytic processes in an "autoirradiation zone", whose yields are strongly dependent on the mole fraction of iodine. (auth)

Properties of Radioactive Materials

Refer also to abstract 14546.

14609 (BARC/I–160) OXALATE COMPLEXES OF ACTINIUM. Jain, H. C.; Mathew, K. A. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 12p. INIS.

Studies conducted on the stability, effect of the solution pH, and the effect of the ratio of concentration of the dissociation forms of organic dibasic acids on the oxalate complexes of actinium are reported. The investigation was carried out using liquid cation exchanger dinonyl naphthalenesulfonic acid (HD). Systems containing two forms of ligand in solution at the same time were studied. The distribution coefficients were determined using ^{228}Ac tracer. The results of complex formation of actinium in oxalate media at pH 2, 3, and 4 are presented. The stability constants cannot be determined accurately in these systems as both the bioxalate and oxalate ions form complexes. (INIS)

14610 (CNEA-319) PREPARATION AND THE PHYSICOCHEMICAL AND BIOLOGICAL PROPERTIES OF A ^{198}Au COLLOID PROTECTED BY GELATIN WITH AN ISOELECTRIC POINT OF 9.2. Caro, R. A.; de Paoli, T.; Hager, A. A.; Radicella, R.; Szyszkowsky, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 12p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The preparation of radiogold colloids (^{198}Au) that are stabilized with gelatin of isoelectric point 9.2 was studied in order to analyze their physicochemical and biological behavior. These colloids have electrophoretic properties and an isoelectric point that demonstrate that the colloidal particles are well defined physicochemical entities which are clearly different from those particles which have been protected with gelatine of pI = 4.7. However, the biological distribution of either colloid, after its intravenous injection, show that, at least in this sense, their properties are almost the same. (auth)

14611 (LA-DC-72-1516) "CALCULATIONAL CHEMISTRY" OF THE SUPERHEAVY ELEMENTS; COMPARISON WITH ELEMENTS OF THE 7th PERIOD. Penneman, R. A.; Mann, J. B. (Los Alamos Scientific Lab., N. Mex.). 1972. 23p. (CONF-720931-2). Dep. NTIS.

From Symposium on the chemistry of the transuranium elements; Moscow, USSR (4 Sep 1972).

Relativistic Dirac-Fock calculations indicate that the periodicity of properties of elements becomes increasingly "non-monotonic" as Z increases. Changes in electronic levels include: increased binding of s and $p_{\frac{1}{2}}$ electrons, decreased binding of $p_{\frac{3}{2}}$ electrons, increased radial extension and lowered ionization energies of d orbitals vs s. There is ample evidence that such changes are observable in known elements particularly those of the seventh period. Prediction of aqueous valences for the translawrencium elements is made. (auth))

14612 (NIIAR-P–118) INFLUENCE OF SALT SOLVENT ON THERMODYNAMICS OF $PuCl_3$ FORMATION REACTION IN THE DILUTED SOLUTIONS OF ALKALI METAL CHLORIDES. Silin, V. I.; Skiba, O. V. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 16p. (In Russian). INIS.

The temperature dependence of the apparent standard electrode potential of Pu was obtained relative to a chlorine electrode, on the basis of investigations conducted earlier on emf measurements of equilibrium measurements of Pu potentials in dilute solutions of $PuCl_3$ (not greater than 5 mole%) in alkali metal chlorides (NaCl, KCl, CsCl, and NaCl–KCl). The radius of the cation (r_{R+}) is related to the emf in the following way: $E^*_{Pu^{3+}/Pu} = -4.345 + 0.79/r_{R+} + [14.89\ (5.6/r_{R+}) \times 10^{-4}\ T]$ volts. The replacement of the salt of the solvent has a significant effect on the magnitude of the partial molar free energy of formation of $PuCl_3$ in the corresponding solvent. (tr-auth)

14613 TRANSPORT OF ^{104}Mo IN A CHLORINE–OXYGEN FLOW. Steinwandter, H. (Technische Univ., Darmstadt, Ger.). Inorg. Nucl. Chem. Lett.; 9: No. 1, 113-16(Jan 1973). (In German).

The transport behavior of ^{104}Mo (from a ^{252}Cf spontaneous-fission source) in streams of N_2, N_2-Cl_2, and $N_2-Cl_2-O_2$ was studied. The results show that while ^{104}Mo is not transported by pure N_2 it is transported by both N_2-Cl_2 and $N_2-Cl_2-O_2$ to almost the same extent, which indicates the formation of volatile oxide chlorides such as $^{104}MoOCl_4$ and $^{104}MoO_2Cl_2$. A reaction path model for the chlorination and oxidation of ^{104}Mo is discussed and the ratio of the mean reaction rate constants ($\bar{k}_{Cl}/\bar{k}_O$) given for the ^{104}Mo system. A comparison of this quantity for the ^{131}Te and ^{104}Mo systems shows that in both cases $\bar{k}_{Cl} \approx 10\bar{k}_O$ and that the formation of chlorides, oxide chlorides and oxides proceeds by a similar reaction mechanism. (UK)

14614 STRUCTURE OF γ-URANYL DIHYDROXIDE, $UO_2(OH)_2$. Siegel, S.; Hoekstra, H. R.; Gebert, E. (Argonne National Lab., IL). Acta Crystallogr., Sect. B; 28: No. 12, 3469-3473(1972).

γ-Uranyl dihydroxide, $UO_2(OH)_2$, is monoclinic, space group $P2_1/c$ with a = 5.560 (3), b = 5.522 (3), c = 6.416 (3) Å, and β = 112.71 (9)°. The observed density is 5.55 g · cm^{-3} and the computed value is 5.56 g · cm^{-3} for two formula weights. The structure was solved with 317 independent reflections recorded with an automatic diffractometer utilizing both double filter and θ/2θ scan techniques. A least-squares refinement based on F gave an R value of 6.1%. The configuration about a uranium atom is a distorted octahedron composed of two O(1) (uranyl) and four O(2) (secondary) oxygen atoms. Each O(2) atom is shared between two octahedra leading to puckered sheets of secondary oxygen atoms distributed within the bc plane. Each O(1) oxygen atom is associated with only one octahedron within a layer but is hydrogen-bonded to an O(2) oxygen atom in an adjacent layer. The structure is very similar to the orthorhombic β-$UO_2(OH)_2$. Postulated coordinates for the β modification at 280°C indicate that the β and γ forms can be related by a shear involving one-half of the hydrogen atoms. Grinding experiments demonstrate the existence of a shear effect. (auth)

14615 σ-BONDED ORGANOMETALLIC COMPOUNDS OF URANIUM (IV). Gebala, A. E.; Tsutsui, M. (Texas A and M Univ., College Station). J. Amer. Chem. Soc.; 95: No. 1, 91-93(10 Jan 1973).

Organouranium compounds, $(\pi\text{-}C_5H_5)_3UR$, containing σ bonds were prepared from $(\pi\text{-}C_5H_5)_3UCl$ and LiR (where R = phenyl, C_6H_5; p-tolyl, $p\text{-}C_6H_4\text{-}CH_3$; and phenylacetylide, C_6H_5) in THF. These compounds are extremely reactive toward both water and oxygen; hydrolysis of $(\pi\text{-}C_5H_5)_3U(C_6H_5)$ in THF results in the release of benzene. Both $(\pi\text{-}C_5H_5)_3U(C_6H_5)$ and $(\pi\text{-}C_5H_5)_3U(C_6H_5)$ have marked thermal stability, ~165 and ~185°C, respectively. Infrared and proton nmr spectra support the presence of uranium bound phenyl and phenylacetylide moieties. Proton assignments made for $(\pi\text{-}C_5H_5)_3U(C_6H_5)$ were confirmed from the spectrum of the more soluble $(\pi\text{-}C_5H_5)_3U(p\text{-}C_6H_4\text{-}CH_3)$ and a contact mechanism suggested to account for the shift of the ortho and para protons relative to the meta. Magnetic susceptibility data (μ_{eff} = 2.72 and 2.88 BM for $(\pi\text{-}C_5H_5)_3U(C_6H_5)$ and $(\pi\text{-}C_5H_5)_3U(C_6H_5)$) are consistent with an unpaired $5f^2$ electronic configuration for uranium. (auth)

14616 DISTRIBUTION OF TRITIUM IN THE FLORIDZIN-^3H MOLECULE. Cabak, J.; Veres, K. (Institutes for Biological Research, Prague). Radiochem. Radioanal. Lett.; 12: No. 6, 331-337(31 Dec 1972).

Floridzin-^3H (II) with a specific activity of 2.61 Ci/mmol was prepared by catalytic hydrogenation of the double bond in 1-(2-glucosido-4,6-dihydroxy)-4-hydroxychalcone with gaseous tritium. By chemical degradation, during which the floridzin molecule was split to several fragments, and by the preparation of new derivatives of floretin (III), it has been found that the addition of tritium to the double bond in chalcone (I) under the conditions of catalytic hydrogenation does not take place evenly. Exchange of the hydrogen atoms for tritium in ring B of floridzin (II) also takes place. (auth)

14617 SYSTEMATIC STUDY OF THE OXIDATION-REDUCTION PROPERTIES OF ELEMENTS. David, F. (Paris Univ., Orsay, France). Radiochem. Radioanal. Lett.; 12: No. 6, 311-324(31 Dec 1972). (In French).

Thermodynamic properties of elements and ions (including rare earths and actinides) are compared within series and columns of the periodic table. Simple relations with atomic number occurs that leads to evaluate some unknown thermodynamic values. (auth)

14618 EXTRACTION OF URANIUM FROM SEA WATER AS A BY-PRODUCT FROM WATER DESALINATION PLANTS. Khan, S. (Atomic Energy Centre, Lahore). Nucleus (Karachi); 9: No. 1-2, 39-46(1972).

It may be possible to recover uranium from seawater economically as a by-product from waste saline water of the seawater desalination plants, if the cost of pumping water and cleaning it of organic matter is charged on the desalted product. A desalination plant producing 250 thousand tons of water per day at a brine concentration factor 2 : 1 would discharge an equal amount of waste saline water containing about 1,500 g of uranium daily. This waste water may be brought into contact with 25 tons of galena (lead sulfide) and the sorbed uranium may be eluted with 10% sodium carbonate solution. After elution, galena grains can be regenerated by washing with dilute hydrochloric acid solution of pH 5.0. (DHM)

14619 EQUATION OF STATE FOR UF_6 OVER THE RANGE OF DENSITY VARIATION TO 0.0118 g/cm^3 AND TEMPERATURE

VARIATION UP TO 367°K. Malyshev, V. V. At. Energ. (USSR); 34: No. 1, 42-44(Jan 1973). (In Russian).

An equation of state has been developed for UF_6 in terms of pressure (P), temperature (T), and density (ρ) which is valid for the following limits: P = 750 mm Hg, T = 367°K, and ρ = 0.01180 g/cm³: $P\mu/\rho RT = 1 + [3.94 - (2.197 \times 10^3/T)\rho]$. Values for the density of saturated vapor of UF_6 and for the heats of sublimation were determined for the temperature range 296.3 to 327.6°K. (KSW)

14620 SPECIAL FEATURES OF THE ELECTRONIC–VIBRATIONAL INTERACTION IN CRYSTALLINE URANYL COMPOUNDS. Kizel, V. A.; Krasilov, Yu. I.; Burkov, V. I.; Madii, V. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 6, 615-618(Jun 1972).

Translated from Opt. Spektrosk.; 32: No. 6, 1134-1140(Jun 1972).

The structure of electron-vibration spectra in cubic crystals of sodium uranyl acetate and a homologous series of uranyl propionates was investigated. The effect of the symmetry of the uranyl complex on the appearance of different vibrations of the uranyl and the ligands in the electronic-vibrational spectra was examined. It is shown that the intensity of the transitions to the symmetric vibrational levels is determined by the symmetry of the uranyl complex, by the character of the electronic-vibrational interaction, and by the type of normal vibrations. (auth)

14621 SOURCES OF ERROR IN THE DETERMINATION OF SPECIFIC RADIOACTIVITY OF AMINO ACIDS ISOLATED BY ION-EXCHANGE CHROMATOGRAPHY. Gaitonde, M. K.; Nixey, R. W. K. (Medical Research Council Neuropsychiatry Unit, Carshalton, Eng.). Anal. Biochem.; 50: No. 2, 416-29(Dec 1972).

The specific radioactivity (dpm/μmole) of individual ^{14}C-labeled amino acids isolated by ion-exchange chromatography was different, in contrast to being constant, in the consecutive fractions of the same amino acid. This phenomenon was attributed to the resolution of ^{14}C- and ^{12}C-amino acids on ion-exchange resin. The specific radioactivity of the amino acid increased during progressive elution from a cation-exchange resin but it decreased during elution from an anion-exchange resin. Therefore, the specific radioactivity of the amino acid cannot be determined at the point of its elution peak; the true specific radioactivity of the amino acid is obtained as a mean specific radioactivity from the total radioactivity and the amino nitrogen content of pooled fractions of that amino acids. The implication of this finding is discussed in the context of compartmentation resulting from the probable competition between ^{14}C- and ^{12}C-amino acids for the enzyme-protein in the course of their metabolism in vivo. The recovery of radioactivity (expressed as dpm after correcting for quenching) of [^{14}C]-γ-aminobutyrate eluted from ion-exchange columns by citrate buffers was not quantitative. This was attributed to the adsorption of the isotope onto the wall of the vial, of variable amounts of the [^{14}C]amino acid in citrate buffers of different molarity at pH 5.1, 5.28, 5.84, and 6.5. The determination of specific radioactivity of [^{14}C]-γ-aminobutyrate under these conditions was shown to give false low values. A method is given for obtaining quantitative recovery of radioactivity of [^{14}C]-γ-aminobutyrate in citrate buffers by liquid scintillation spectroscopy. (auth)

14622 VIBRATIONAL SPECTRA OF CHEMICALLY SPUTTERED URANIUM OXIDE MOLECULES ISOLATED IN NOBLE GAS MATRICES. Carstens, D. H. W.; Gruen, D. M.; Kozlowski, J. F. (Argonne National Lab., IL). High Temp. Sci.; 4: No. 5, 436-44(Oct 1972).

Using a hollow-cathode sputtering device, UO, UO_2, and UO_3 molecules were prepared and isolated in argon matrices. Vibrational assignments for UO_2 and UO_3 agree with those of Gabelnick, Reedy, and Chasanov. In addition, bands were observed at 820 cm^{-1} (using $^{16}O_2$) and 777 cm^{-1} (using $^{18}O_2$), which are most reasonably assigned to $U^{16}O$ and $U^{18}O$, respectively (auth)

14623 MACROAGGREGATION OF AN ALBUMIN-STABILIZED TECHNETIUM–TIN(II) COLLOID. Lin, M. S.; Winchell, H. S. (Univ. of California, Berkeley). J. Nucl. Med.; 13: No. 12, 928-931(Dec 1972).

A stable ^{99} Tc-Sn(II) colloid is prepared by mixing an aqueous Sn(II) solution and ^{99m}Tc generator eluate followed by adding a stabilizer to the mixture. This colloid can be converted into a ^{99m}Tc-labeled macroaggregate that is not fragile but metabolizable and has a controlled size limit. A two-stage method is used. In the first stage, the colloid is heated to convert it into a suspension of oversize aggregates. In the second stage, the oversize aggregate is forcefully disrupted into fragments and the fragments still exceeding 150 μ are removed with a sieve. (MCG)

14624 MELTING POINT DIAGRAMS OF TERNARY SYSTEMS CONTAINING $MgCl_2$, $CaCl_2$, UCl_3, AND UCl_4. Desyatnik, V. N.; Mel'nikov, Yu. T.; Raspopin, S. P.; Trifonov, I. I. At. Energ. (USSR); 33: No. 6, 994-995(Dec 1972). (In Russian).

Two melting point diagrams were constructed for systems containing $MgCl_2$, $CaCl_2$, and either UCl_3 or UCl_4 as the third component. Binary system data already in the literature were utilized. Both systems were monoeutectic. In one system the eutectic UCl_4–38 mole % $CaCl_2$–9 mole % $MgCl_2$ melted at 487°C. In the second system the eutectic had the composition $CaCl_2$–31 mole % $MgCl_2$–20 mole % UCl_3 and melted at 600°C. (KSW).

Radioactive Waste Treatment

Refer also to abstract 14578.

14625 (ARH-SA-111) USE OF WELLS IN THE REMOVAL OF MOTHER LIQUOR FROM SALT CAKES. Metz, W. P. (Atlantic Richfield Hanford Co., Richland, Wash.). [nd]. Contract AT(45-1)-2130. 25p. (CONF-720128-1). Dep. NTIS.

From Regional symposium of American Institute of Chemical Engineers; Corvallis, OR (28 Jan 1972).

Radioactive wastes from the Hanford production facilities are solidified in massive salt cakes in large underground storage tanks. The use of salt wells with pumps for removal of mother liquor, thereby producing a drained immobile salt cake, is described. The first well design consisted of an 8-in. pipe casing with 4 feet of 0.050-in. screen, with a solid steel-pointed end. A steam-water sluice line was run to the point to facilitate well installation. The 8-in. well was chosen to accommodate an available 5 hp pump. Two test wells demonstrated the feasibility of the process. (MCG)

14626 (BNWL–1699) RESEARCH AND DEVELOPMENT ACTIVITIES, WASTE FIXATION PROGRAM. Quarterly Progress Report, July–November 1972. Platt, A. M. (comp.) (Battelle Pacific Northwest Labs., Richland, Wash.). Dec 1972. Contract AT(45-1)-1830. 49p. Dep. NTIS.

Two waste compositions have been selected for study during the WFP. A low-salt, or "clean" waste, designated PW-4b, represents a waste from a fuel reprocessing plant wherein no chemical salts are added during processing. A high-salt or "dirty" waste, designated PW-6, represents a waste which is modestly high in chemical salts which are added during processing. Preliminary tests indicate up to 35 wt% PW-6, as oxide, can be incorporated in homogeneous borosilicate glasses which have low leach rates and low viscosities and which are relatively noncorrosive to high chromium-high nickel alloys. Up to about 20 wt% PW-4b, as oxide, has been incorporated in a lead silicate glass which is even more leach resistant. In corrosion tests to select a metal for a melter material, 10 commercial alloys corroded at rates of ≤10 mils/month during 425 hours in a selected PW-6 borosilicate melt held at 1150°C. Of the five WSEP phosphate glass pots that have been core drilled, three were found to be almost completely devitrified while two were only partially devitrified. When devitrification of phosphate glass occurs, the leachability of cesium increases by a factor of approximately 10^3 but the leachability of cerium increases by only a factor of approximately 10. (auth)

14627 (RT/PROT–(72)23) PROGRAM ESTER: SOLIDIFICATION OF WASTE LIQUID OF HIGH ACTIVITY. Bocola, W.; Donato, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 13 Jul 1972. 38p. (In Italian). Dep. NTIS (U. S. Sales Only).

By means of a suitable bench-scale laboratory plant 27 solidification runs were carried out. Six different simulated fission products solutions, of the PUREX type, were selected and solidified to phosphate glasses by means of red phosphorus and/or phosphoric acid. The fission products oxides content in the solids was in the range 2 to 16% (mole), while that of P_2O_5 was 21 to 62% (mole). The leach factor, measured in distilled water at 95°C, was, on the average, 10^{-5} gcm^{-2} d^{-1}. The ruthenium volatilization was lower than 0.75%, when red phosphorus was used as glass former additive, but ranged between 2 and 64% in the case of phosphoric acid. The sulfate loss was lower than 0.5%. The Cs, Fe, and Na losses ranged between 0.01 and 1%. About 80% of the nitrates recovered in the plant (at 90%) were found in the pot condensates. The process tested resulted in satisfactory and flexible treatment of different fission products solutions when phosphoric acid was employed. However, some troubles were met using red phosphorus, which at the moment seems suitable only for the treatment of very clean wastes. (auth)

14628 (STI-PUB-(Vol. 11)) PEACEFUL USES OF ATOMIC ENERGY. Volume 11. Proceedings Series. Proceedings of the Fourth International Conference Held at Geneva, Switzerland, September 6–16, 1971. (International Atomic Energy Agency,

Vienna (Austria)). Apr 1972. 775p. (In Several Languages). (CONF-710901-Vol. 11). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sep 1971).

This volume contains papers on health physics and radiation protection, radioactive waste management, and environmental effects and public acceptance of nuclear energy. (DHM)

14629 ADSORPTION PROPERTIES OF AMMONIUM MOLYBDOPHOSPHATE SUPPORTED IN PORES OF SILICA GEL. Caletka, R.; Konecny, C. (Nuclear Research Inst., Rez, Czech.). Radiochem. Radioanal. Lett.; 12: No. 6, 325-329(31 Dec 1972).

The preparation procedure for the ammonium molybdophosphate ion exchanger is described together with the results of testing its suitability for cesium recovery from acid solutions. (auth)

14630 METHOD FOR THE CONCENTRATION OF RADIOACTIVE WASTES. Doellgast, W. (to Siemens AG). German Patent 1,764,586. 10 Feb 1972. (In German).

A method is presented for the solidification of liquid waste concentrates and suspensions. In order to prevent dusting, bone glue as embedding material is added to the concentrate prior to drying. After addition of polyacrylamide for fixation of a suitable viscosity the mixture is dried on heated rollers at temperatures above 130°C and the rolled stock is pressed. (Germany)

14631 METHOD FOR THE REMOVAL OF RADIOACTIVE IMPURITIES FROM MIXED-BED ION EXCHANGE RESINS. Noble, J. H. (to Stone and Webster Engineering Corp.). German Patent 1,527,954. 6 Apr 1972. (In German).

A method for the decontamination and regeneration of mixed-bed ion exchangers is proposed. A diluted aqueous solution of alkali halides, e.g., NaCl, is led from the bottom to the top of a contaminated resin bed, thus a concentrated alkali halide solution in the opposite direction. The flow rate of the diluted solution is fixed in that way, that the resin volume is increased by about 25%. After passage through the resin bed the diluted solution is evaporated and the solid radioactive residue can be disposed of in the usual manner. The concentrated solution, however, which contains comparatively little activity, can be diluted and reused for a first regeneration step. (Germany)

Radioisotope Production

Refer also to abstracts 15470 and 16089.

14632 (ORNL-4731) LABORATORY DEVELOPMENT OF A PRESSURIZED CATION EXCHANGE PROCESS FOR REMOVING THE DAUGHTERS OF ^{232}U FROM ^{233}U. Rainey, R. H. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 54p. Dep. NTIS.

A pressurized cation exchange process was developed for decreasing the gamma activity due to the daughters of ^{232}U usually associated with ^{233}U so that the ^{233}U may be handled with minimal shielding. The process involves passing a $^{233}UO_2(NO_3)_2$ solution containing a few ppM of ^{232}U through a bed of cation exchange resin on which the long-lived daughters of ^{232}U are sorbed. The uranium-containing effluent is held for 2 days to permit decay of the short-lived daughters. The gamma activity in the resulting product solution is less than 2% of the equilibrium value and remains below this level for about 3 weeks. Chemical and physical parameters involved in the process were evaluated on a laboratory scale. Data developed in the laboratory were used in the design and construction of a plant that was a thousand times larger than the laboratory scale. Operation of this plant confirmed laboratory results. (auth)

14633 EXCITATION FUNCTIONS FOR DEUTERON INDUCED REACTIONS ON ZINC. Nassiff, S. J.; Muenzel, H. (Kernforschungszentrum, Karlsruhe, Ger.). Radiochem. Radioanal. Lett.; 12: No. 6, 353-361(31 Dec 1972).

Excitation functions for the production of ^{65}Ga, ^{66}Ga, ^{67}Ga, ^{65}Zn, ^{69m}Zn, and ^{71m}Zn by irradiation of natural zinc with deuterons below 23 MeV were experimentally determined. The bombardments were performed with the Karlsruhe Isochronous Cyclotron, using the stacked foil technique. (auth)

14634 PREPARATION AND APPLICATION OF TRANSURANIUM ELEMENTS. Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). Naturwiss. Rundsch.; 25: No. 9, 331-42(1972). (In German).

A general review is presented on the production and synthesis of the transuranium elements in which context the different possibilities for the buildup, production in nuclear reactors, by means of nuclear explosions, or by means of nuclear reactions with heavy ions, are demonstrated using some practical examples. In addition, the efforts in producing superheavy elements in the region of doubly magic nuclei with Z = 114 and 164 with the help of destined heavy-ion reactions are outlined. Furthermore practical applications of transuranium elements as fuels, as energy, or radiation sources in various fields of research and technology are reported. (Germany)

Reactor Fuel Reprocessing

Refer also to abstracts 14496 and 16612.

14635 (DOCKET—50201-138) WEST VALLEY REPROCESSING PLANT. Technical Specifications, Change No. 18. (Nuclear Fuel Services, Inc., Rockville, Md.). 22 Dec 1972. 71p. Dep. NTIS.

The modifications authorized were requested to update specifications to reflect plant modifications and operational changes based on operating experience or to reflect changes in the bases of specifications. It was determined that the requested changes do not present significant hazards considerations not described or implicit in the Final Safety Analysis Report. Twenty three authorized Technical Specifications and revised pages are given. (MCG)

14636 (STI/PUB-300(Vol.8)) PEACEFUL USES OF ATOMIC ENERGY, VOLUME 8. Proceedings of the Fourth International Conference, Geneva, 6-16 September 1971. (International Atomic Energy Agency, Vienna (Austria)). 1972. 577p. (In several languages). (CONF-710901-(Vol.8)). IAEA $14.00.

This volume contains papers on uranium and thorium ore resources and fuel fabrication and reprocessing. (DHM)

ENGINEERING

Energy Conversion

Refer also to abstracts 14690, 14695, 16316, 16344, 16569, and 16849.

14637 (AD-823842) RADIOISOTOPE THERMIONIC GENERATOR RESEARCH. Harbaugh, W. E.; Turner, R. C.; Longsderff, R. W. (Radio Corp. of America, Lancaster, Pa.). Oct 1967. Contract AF33(615)-5095. 153p. (AFAPL-TR-67-111). NTIS.

Results of an investigation into the development of a thermionic module/heat pipe power/conditioner system to achieve useful power of 500 watts at 28 volts dc from a radioisotope primary power source are reported. (auth)

14638 (AD-824147) GROUND POWER THERMOELECTRIC GENERATOR MODULE. Technical Report, December 1966-December 1967. Magladry, Robert; Zindler, George (Martin Marietta Corp., Baltimore, Md. Nuclear Div.). Oct 1967. Contract F33615-67-C-1260. 117p. (AFAPL-TR-67-137). NTIS.

Recent work on high-power density thermoelectric elements is described. The work encompasses thermoelectric design and analysis, element development and fabrication and element operations. Sixty-two elements were fabricated and tested and 59 were analyzed under the program. The final 14 were jacketed insulated elements. (auth)

14639 (AD-847293) DEVELOPMENT OF A HIGH-EFFICIENCY CASCADED THERMOELECTRIC MODULE. Summary Report, May 1967-December 1968. Rocklin, S. R.; Leonard, W. D.; Saunders, R. C. (Atomics International, Canoga Park, Calif.). Jan 1969. Contract F33615-67-C-1822. 154p. (AI-69-2; AFAPL-TR-68-144). NTIS.

The analytical techniques, including a computer code, required to optimize the design of a cascaded segmented thermoelectric module using SiGe and PbTe was established. System concept studies were carried out which defined the effect of system parameters on module design and demonstrated the advantages of the use of the cascaded module with an isotope heat source to provide a lightweight radioisotope thermoelectric generator (RTG) space power supply. (auth)

14640 (COO-4125-2) PERFORMANCE COMPARISON OF NIOBIUM, MOLYBDENUM, AND TUNGSTEN COLLECTORS. Rufeh, F.; Gunther, R.; Lieb, D. (Thermo Electron Corp., Waltham, Mass.). Jan 1972. Contract AT(30-1)-4125. 59p. Dep. NTIS.

Thermionic performance data on single crystal W collectors and polycrystalline W collectors with chloride tungsten emitters are presented and discussed. These performance data are also compared with those obtained using Nb and Mo collectors with tungsten chloride emitters. (JRD)

14641 (N-72-25609) OUT-OF-CORE EVALUATIONS OF URANIUM NITRIDE FUELED CONVERTERS. Shimada, K. (Jet Propulsion Lab., Pasadena, Calif.). 1 May 1972. Contract NAS7-100. 11p. (NASA-CR-126864; JPL-TM-33-545). NTIS.

Two uranium nitride-fueled converters were tested parametrically for their initial characterization and are currently being life-tested out of core. Test methods being employed for the parametric and the diagnostic measurements during the life tests, and test results are presented. One converter with a rhenium emitter had an initial output power density of 6.9 W/cm^2 at the black body emitter temperature of 1900°K. The power density remained unchanged for the first 1000 h of life test but degraded nearly 50% during the following 1000 h. Electrode work function measurements indicated that the uranium fuel was diffusing out of the 0.635 mm emitter cladding. The other converter with a tungsten emitter had an initial output power density of 2.2 W/cm^2 at 1900°K with a power density of 3.9 W/cm^2 at 4300 h. The power density suddenly degraded within 20 h to practically zero output at 4735 h. (auth)

14642 STUDY OF POWER OUTPUT OF A SILICON SOLAR CELL STACK. Atta, M. A.; Ahmad, K.; Anjum, F. (Atomic Energy Centre, Lahore). Nucleus (Karachi); 9: No. 1-2, 75-82 (1972).

A systematic study of power output from a solar stack at various inclinations to the horizontal has been made. The angle of inclination for each month of the year has been optimized with respect to the power output. The losses in the power output are assessed and suggestions made to minimize the losses. It was found that power output could be increased by 10% by keeping the stack at optimum angles. (auth)

14643 OPTICAL METHODS OF MEASURING PLASMA TEMPERATURES IN COMBUSTION CHAMBERS AND MHD-GENERATOR CHANNELS. Licki, J. (Instytut Badan Jadrowych, Warsaw). Pomiary, Automat., Kontr.; 18: 108-109(Mar 1972). (In Polish).

The essential features of temperature measurements performed by the line reversal method and by recording the intensity of the spectral line center are examined. A spectral temperature recorder which uses the second of those methods to measure plasma temperatures in MHD channels and combustion chambers is described. The error of the device is shown to be less than 1%. (IAA)

14644 ENERGY SUPPLY IN OUTER SPACE. Blumenberg, J. Phys. Unserer Zeit; 3: No. 4, 117-22(1972). (In German).

Following a general outline of the increasing demand for electric energy for spacecrafts, estimates are presented of the energy requirements for communications (television) satellites, manned space stations, and for electric propulsion systems. A description is given of the fundamentals of the use of chemical, nuclear, and solar primary energy in electricity supply units for interplanetary systems. Comments are given on further trends in the development of power sources, energy converters, and radiation coolers. (GF)

14645 ENERGY CONVERSION DYNAMICS. Messerle, H. K. (Univ. of Sydney). Energy Convers.; 13: No. 1, 19-23(Jan 1973).

A general approach to the transient analysis of energy conversion devices and systems is established by combining the concepts of energy conversion statics and irreversible thermodynamics. The approach leads directly to a state space representation of the performance relations for a system without the need for the invention of artificial loss functions and state functions as required when starting from classical electromechanics. In a system consisting of interconnected elements the connection relations lead to general transformations which are shown to be orthogonal due to the requirement of power invariance. (auth)

14646 FEEDBACK CONTROL OF IONIZATION INSTABILITY IN MHD GENERATORS. Sen, A. K. (Technische Hogeschool, Eindhoven, Netherlands). Energy Convers.; 13: No. 1, 13-17 (Jan 1973).

A scheme of stabilization of ionization instability by linear feedback is presented. The electron density perturbation of an ionization wave is sensed by a biased single probe, appropriately processed by an active electronic network and fed back into the nonequilibrium plasma. The feedback signals in form of currents are injected into the plasma via pairs of small control electrodes. The necessary structure of the electronic network is indicated and it is shown that for reasonable parameters of this network, stabilization can be achieved. (auth)

14647 APPARATUS FOR CONVERSION OF NUCLEAR ENERGY INTO ELECTRIC ENERGY. Greatbatch, W. (to Wilson Greatbatch Ltd.). Danish Patent 200,571. 17 Jan 1972. Priority date 11 May 1970, United States. (In Danish).

Apparatus is described for conversion of nuclear energy into electric energy characterized by comprising a radioactive nuclide that emits beta-particles under radioactive decay, and that is surrounded by an energy-converting material with opposite types of conduction that meet at a junction, and in which electron hole pairs are formed in the mentioned types by bombardment with beta-particles from the nuclide. Each of the mentioned types in the converter material is connected to an output terminal so that an electric potential is generated over these terminals dependent upon the flow of electrons and holes over the mentioned junction. Various features make the apparatus suitable as energy source for a cardiac pacemaker during a person's childhood and adolescence. (Denmark)

14648 SINGLE ELEMENT ΔT_{max} THERMOELECTRIC MEASUREMENT TECHNIQUE. Stanley, M. L. (Aerojet Nuclear Co., Idaho Falls, ID): Reich, A. D.; Ybarrondo, L. J. Energy Convers.; 13: No. 1, 7-12(Jan 1973).

Two large-signal measurement techniques are presented for determining the maximum operating performance of a single sample of thermoelectric material. The experimental and analytical techniques are somewhat similar to the Harman Z (figure-of-merit of thermoelectric material) meter, with the distinction that they eliminate rather than correct for the problem of non-trivial lead interaction with the measurement. Predictions of thermoelectric material performance are compared with experimental measurements with good agreement. (auth)

Facilities and Equipment

Refer also to abstracts 14704 and 16565.

14649 (COO-1630-13) IMPROVED AEROSOL GENERATOR. (Wayne State Univ., Detroit, Mich. Dept. of Occupational and Environmental Health). 25 Feb 1970. 16p. Dep. NTIS.

An aerosol generator is described which compensates for changes in the concentration and volume of solutions during aerosolization to produce airborne particulates of unchanging characteristics. (JRD)

14650 (KFK-1558) EXPERIMENTAL CONTRIBUTION TO THE DEVELOPMENT OF AN INJECTION EVAPORATOR. Gaballah, I.; Wiehr, K. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorbauelemente). May 1972. 33p. (In German). Dep. NTIS (U. S. Sales Only).

An injection-evaporator test rig was set up to check a theory for calculating the evaporation process of water drops of different sizes in an evaporator channel of any sectional area, taking into account the mass, heat, and momentum exchange between the water and vapor phases. An injection system has been developed which consists of several injection units delivering one vapor and one water jet each bouncing vertically against each other (rebound jet evaporator) and ensuring controllable atomization. The comparison of theoretical and experimental results yields good agreement. Aspects are discussed which allow a further increase in the power density of an injection evaporator. (auth)

14651 (KFK-1628) INTEGRATED DESIGN AND OPTIMIZATION OF SODIUM/SODIUM HEAT EXCHANGERS WITH COMPUTER ASSISTANCE. Schnauder, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut Fuer Reaktorentwicklung). Oct 1972. 29p. Dep. NTIS (U.S. Sales Only).

The SINEX code allows the design of sodium/sodium intermediate heat exchangers for the steady-state reference operating. The novel feature of the program system consists in the combination of thermal and mechanical calculations. A graphic output has been incorporated. A simplified cross section of each heat exchanger calculated can be plotted. In parameter calculations the influence of the different parameters can also be plotted automatically in diagrams. As an example of the application of the program system, sodium/sodium intermediate heat exchangers, made of three different grades of austenitic steel, are compared with each other in terms of cost. (auth)

14652 DESIGN PROBLEMS FOR A VAPOR CIRCULATOR FOR TEST LOOPS. Centemeri, L. (Franco Tosi SpA, Legnano, Italy). pp 167-96 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

In the development of a vapor circulator for test loops, the primary areas of interest are the fluid dynamics design, the mechanical design, and the tightness. Each of these is discussed in detail. (JSR)

14653 RESULTS WITH A HYDROSTATIC COMPACTION FACILITY UP TO 15,000 ATMOSPHERES. Bumm, H.; Liepelt, H. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Werkstofftech.; 3: No. 7, 364-8(1972). (In German).

A new facility for producing hydrostatic pressures up to 15,000 atmospheres is described. Results of hydrostatic compaction of several metal-, oxide-, carbide-, boride- and nitride-powders up to 15,000 atmospheres are presented and discussed. The effects appearing during compaction are described qualitatively considering a recently investigated fragmentation process. (GF)

14654 DRY SEALED-MECHANICAL PUMPS. Tanguy, L. (Societe de Recherches Techniques et Industrielles, Buc, France). Vide; No. 157, Suppl., 160-6(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

Dry sealed mechanical pumps designed to meet the requirements of the nuclear industry (problems related to the transfer of gases which are corrosive, toxic, sensitive to humidity, or costly) are presented. (France)

14655 CENTRIFUGE SEPARATOR. Kotrappa, P.: Light, M. E. (to United States Atomic Energy Commission). U. S. Patent 3,698,626. 17 Oct 1972. Filed 17 May 1971.

A centrifuge separator with spiral channel of expanding width from the center of the spiral, to receive material to be separated at the center of the spiral, and with means for laminarly flowing a stream of gas through the channel to carry the material therethrough and for collecting separated materials at different locations along the outer wall of the channel is described. (Official Gazette)

14656 LABYRINTH INVESTIGATIONS CARRIED OUT ON A 14 MeV-NEUTRON GENERATOR. Adler, B.; Knobus, B. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 3, 116-17(Mar 1972). (In German).

The design of a labyrinth for a 14-MeV neutron generator is presented. Arrangement of walls and shielding is indicated as well as their composition of concrete, paraffin, and boric acid-containing paraffin. Also given are the neutron and gamma doses at various points of the arrangement. From the measurements, specifications and recommendations for the design of future labyrinths are listed. (H.B.G.)

Heat Transfer and Fluid Flow

Refer also to abstracts 14516, 14650, 14651, 16510, 16532, and 16553.

14657 (EUR-4879) NATURAL CONVECTION HEAT TRANSFER IN POROUS MEDIA. (Société Bertin et Cie, Plaisir (France)). Nov 1972. 80p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 125,-.

Prestressed concrete pressure vessels for nuclear reactors need an internal thermal protection whose main element is a thermal insulant working in a high density fluid environment. The majority of the materials suitable for use as insulants are porous. A study was carried out in order to improve the knowledge on heat transfer through thermal insulants; it was related to a tight rectangular cell, completely filled with a porous medium, namely a homogeneous porous structure with high porosity and an enclosed monophasic fluid. If two opposite faces of such a cell are different in temperature the heat flow between these faces proceeds by conduction through the structure, by radiation and by natural convection of the fluid. A comprehensive theory was achieved. The validity of formulation and solving methods is shown by a fair agreement between experimental and theoretical results for different conditions. General correlations are given for the prediction of heat transfer in a rectangular enclosure filled with a porous medium. The basic knowledge compiled for this study thus helps to understand the phenomena occurring in an insulation. (auth)

14658 (FEI-284) TAKING INTO ACCOUNT THE THERMAL RESISTANCE OF A LIQUID METAL TO HEAT EXCHANGE IN AN ANNULUS. Kirillov, P. L. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). 1971. 18p. (In Russian). INIS.

The nature of thermal contact resistance at a liquid metal-wall boundary is considered. Hypotheses are proposed for explaining this phenomenon: the thermal contact resistance under static conditions depends on the purity of the liquid metal and the surface, their heat conductivities, and probably is to a significant degree connected with the partial wettability of the wall (gas pockets at the boundary); during forced flow the thermal resistance depends on the presence on the surface of various types of films, and on the purity of metal and the deposit of impurities on the wall; the maximum value of thermal resistance, associated with the impurities deposited on the wall during coolant boiling may be evaluated by the formula $(R_k \lambda/d)_{max} = 200/Re^{0.75}$. (tr-auth)

14659 MEASUREMENT OF DENSITY PROFILES IN CYLINDERS OF AIR USING SOFT X-RAY TRANSPORT. Couch, R. P.; Battle, E. L. (Wright-Patterson AFB, Dayton, OH). pp 451-63 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The development of advanced propulsion devices requires detailed knowledge of the state of the emergent flowing gas. Free stream density is one of the most important, and most difficult to measure, properties in a high-enthalpy supersonic or hypersonic flow field. A new method, referred to as a transport method, is described which measures the spatial density distribution in an axisymetric flow field by using wide x-ray beams with non-uniform flux distributions and detection of the transported x-rays with simple uncollimated detectors distributed around the periphery of the exhaust plume. Experimental and calculated results for this density measuring method are compared. (LCL)

14660 TRANSFER OF NUCLEAR HEAT TO REDUCTION PROCESSES IN INDIRECT HEAT EXCHANGERS. Reichenbach, B. Aachen; Technische Hochschule (1971). 90p. (In German).

Thesis.

Technical problems arising in indirect heat transfer are examined. Theoretical considerations lead to the development of model concepts which offer the possibility of calculating various parameters affecting the process. This is followed by the description of the technological concept of a heat-exchanger element and its development on a laboratory scale. Experiments are described which are aimed at investigating the servicable life, and thus the economy of operation, by means of newly developed high-temperature wear tests. (GF)

14661 INVESTIGATION OF PRESSURE DROP AND HEAT TRANSFER IN ROD BUNDLES. Markfort, D. Hanover; Technische Univ. (1971). 125p. (In German).

Thesis.

The equations for the pressure drop coefficient and the Nusselt number have been modified by correction factors which take into account the actual energy of the flow and its impulse, as well as the relationship between the medium and bulk temperature of the fluid. The correction factors are dependent on the velocity or temperature profile, which can be generally derived for any cross section of the flow channel. The results of fluid flow experiments with a 19-rod bundle are in good agreement with the theoretical predictions for velocity and temperature profiles in the region $20,000 < Re < 100,000$. It is possible to explain theoretically the deviations above and below that region. For laminar flow, the pressure drop coefficient reaches the theoretical value at $Re = 1,000$. This agreement could not be obtained using present correlation methods. It was not possible to determine the Nusselt numbers experimentally for the lamanar flow region. (GF)

Materials Testing

Refer also to abstracts 15196, 15217, 16519, 16520, and 16808.

14662 (EUR-4774) STUDIES OF CERTAIN CHARACTERISTICS OF AN EMITTING-RECEIVING ULTRASONIC PROBE. Part 1. Study of the Configuration of the Ultrasonic Beam. Part 2. Determination of the Electric Equivalent Circuit of a Transducer. Juranville, G. J. A. (European Atomic Energy Community, Ispra (Italy)). Dec 1972. 132p. (In French). Dep. NTIS (U.S. Sales Only). EUR FB 175,-.

The ultrasonic immersion testing method for detecting flaws in metals is very critical, especially when quantified results are required. The probe should have a high sensitivity for detecting small discontinuities and a short ringing time to discriminate clearly reflections from the material boundaries and adjacent defects; additionally, to insure reproductive results it is absolutely necessary to have precise information concerning the sound beam and the electrical data of each transducer. To assemble these characteristics on a transducer data-sheet, the sound beam was investigated and the electrical behavior of the transducer was analyzed. Results of studies on configuration of the ultrasonic beam are presented along with data for determination of the electric equivalent circuit of a transducer. (auth)

14663 EXPERIENCE IN EDDY CURRENT TESTING OF TUBES FOR HEAT EXCHANGERS BY USING AN INTERNAL COIL SYSTEM. Heckhaeuser, H. (Vereinigte Deutsche Metallwerke AG, Duisburg, Ger.). Materialpruefung; 14: No. 10, 341-5(1972). (In German).

The principle of flaw detection by using eddy current ring coils and the application of testing tubes for heat exchangers are described. The purpose of tube testing by an eddy current internal coil and the experience in practice are explained. The test results show the relation between the form of material defects and the test indications by using an eddy current inside the coil system, and its application as a test procedure for heat exchanger tubes for nuclear power plants is described. (GF)

14664 NEUTRON RADIOGRAPHY. Hilditch, J.; Chrimes, N. W. (Australian Atomic Energy Research Establishment, Lucas Heights). Test. Instrum. Contr.; 9: No. 12, 13-24(Dec 1972).

A neutron radiograph can be prepared in a fashion somewhat analogous to that of an x-ray photograph. The transparency of materials to a neutron beam depends on the nuclear properties of the elements in the material and does not depend strongly on density. Thus neutron radiography is, in some respects, complementary to x-radiography. The facilities required and the techniques for recording neutron radiographs are described. Typical examples of application to nuclear and industrial problems are given. (auth)

14665 STRAIN-GAGE TECHNIQUE IN THE NUCLEAR FIELD. APPLICATION POSSIBILITIES AND LIMITATIONS. Morandi, G. (CISE, Milan). pp 453-68 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

Two examples are given of the use of strain-gage measurements. In the first a resistance strain gage was used to measure the expansion of the IFA 32 fuel elements. In the second example, the stresses on the internal structure of a reactor were verified. (JSR)

14666 NEUTRON RADIOGRAPHY AND ITS APPLICATIONS. Giannini, M. pp 481-93 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The random fluctuation of the neutron attenuation with the atomic number and the fact that neutron radiography of highly radioactive objects is possible are two reasons for the interest in neutron radiography. The technique of this nondestructive method is briefly described. Its possible applications, especially radiography of highly radioactive fissile material, are discussed. (JSR)

14667 COLOR RADIOGRAPHY: EXPERIENCE AND EVALUATION OF USE. Cappabianca, C.; De Jaco, L. pp 495-508 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The technique of color radiography is briefly outlined. Tests were made to reduce the processing time without affecting the definition and to verify the influence of the salt screens on the sensitivity of the films. The results are tabulated. Comparative films were also taken in black and white. (JSR)

14668 EFFECT OF MISALIGNMENT OF BETATRON FLAW DETECTOR ON ITS SENSITIVITY. Aizenshtein, R. A.; Gorbunov, V. I.; Shubovich, S. I. (Tomsk Polytechnic Inst., USSR). Sov. J. Nondestruct. Test. (Engl. Transl.); 8: No. 1, 96-9(1972).

Translated from Defektoskopiya; 8: No. 1, 113-17(1972).

The drop of detection sensitivity resulting from axial misalignment of the radiation source and detector is analyzed. The dependence of the loss of integral intensity as a function of the degree of misalignment is given. A nomogram is constructed from which the necessary kinematic accuracy of betatron alignment mechanisms can be found. (auth)

14669 1972 ANNUAL BOOK OF ASTM STANDARDS. PART 30. Philadelphia; American Society for Testing and Materials (1972). 1559p. $44.00.

ASTM standards and tentatives relating to general testing methods, radioisotopes and radiation effects, statistical methods, appearance of materials, emission, molecular, and mass spectroscopy, sensory evaluation of materials and products, chromatography, temperature measurement, space simulation, resinography, microscopy, and deterioration of nonmetallic materials are included. In the serial designations prefixed to the titles of the standards, the number following the dash indicates the year of original issue as tentative or of adoption as standard or, in the case of revision, the year of last revision. Thus, standards adopted or revised during the year 1972 have as their final number, 72. A letter following this number indicates more than one revision during that year, that is 72a indicates the second revision in 1972, 72b the third revision, etc. Tentatives are identified by the letter T. Standards that have been reapproved without change are indicated by the year of last reapproval in parentheses as part of the designation number, for example, (1972). (PCH)

14670 1972 ANNUAL BOOK OF ASTM STANDARDS. PART 31. Philadelphia; American Society for Testing and Materials (1972). 1189p. $35.00.

ASTM standards and tentatives relating to metals, including physical, mechanical, nondestructive, and corrosion tests, metallography, fatigue, and effects of temperature are listed. In the serial designations prefixed to the titles of the standards, the number following the dash indicates the year or original issue as tentative or of adoption as standard or, in the case of revision, the year of last revision. Thus, standards adopted or revised during the year have as their final number, 72. A letter following this number indicates more than one revision during that year, that is, 72a indicates the second revision in 1972, 72b the third revision, etc. Tentatives are identified by the year of last reap-

proval in parentheses as part of the designation number, for example, (1972). A subject index is included. (PCH)

14671 AUTOMATIC RADIATION FLAW DETECTOR FOR THE CONTROL OF ARTICLES MADE FROM HETEROGENEOUS MATERIALS. Vorob'ev, V. A.; Kuvran, V. K. Defektoskopiya; No. 4, 121-6(1972). (In Russian).

Questions of sensitivity in radiation methods are discussed in connection with the quality control of articles fabricated from materials heterogeneous in structure. A method for the mathematical treatment of shadowgraphs is explained which eliminates causes of sensitivity loss. An actual scanning device was used to obtain data for the illustration of this method. (tr-auth)

14672 SOMP POTENTIALS AND FRONTIERS OF NONDESTRUCTIVE TESTING AND EVALUATION. PART I. Li, S. T.; McGonnagle, W. J. Int. J. Nondestruct. Test.; 4: No. 3, 215-29 (Dec 1972).

The methods of nondestructive testing techniques are discussed. These include acoustic emission or stress emission, ultrasonic-spectroscopic analysis, ultrasound imaging, ultrasonic critical-angle reflectivity, and ultrasonic holography. (TFD)

14673 PATTERN CLASSIFICATION IN SCAN-TYPE NONDESTRUCTIVE TESTS. Hsiung, C. Y.; Cox, C. W. (South Dakota School of Mines and Tech., Rapid City). Int. J. Nondestruct. Test.; 4: No. 3, 231-47(Dec 1972).

An investigation of the feasibility of applying pattern-classification methods to multi-channel signals from nondestructive tests is reported. The general pattern classifying machine is discussed; then the specialized version appearing most applicable to nondestructive testing is described in detail. A training method developed for this application is described. A two-channel machine identifying three categories is realized by both digital and analog means, and test results are presented. (auth)

14674 LEAKAGE FIELD METHODS OF DEFECT DETECTION. Lord, W.; Oswald, D. J. (Coloradoa State Univ., Fort Collins). Int. J. Nondestruct. Test.; 4: No. 3, 249-74(Dec 1972).

Leakage field methods of defect detection in ferromagnetic materials can be classified according to both method of specimen magnetization and method of defect signal detection. A comparative study of these various classifications is described and an introduction to a new method of specimen magnetization, the generated reaction field, is presented. (auth)

14675 SOME RESULTS USING THE ULTRASONIC GONIOMETER (THE CORNER REFLECTOR METHOD). Weston-Bartholomew, W. (Univ. of Warwick, Coventry, Eng.). Int. J. Nondestruct. Test.; 4: No. 3, 275-82(Dec 1972).

The ultrasonic goniometer is a tool for the use in nondestructive testing. Its use is increasing. There are many problems that are to be solved in trying to interpret the results. The amplitude of the reflected signal from the specimen at the critical angle is a function of the elastic property of the specimen, and the exciting frequency. The results of experiments conducted on materials in various mechanical states and at different frequencies are given. The change of critical angle was measured. The results show that the corner reflection method could be used to investigate surface-hardened specimens using the frequency effect to measure the case depth. Specimens in different state of creep were also examined and a frequency dependence effect was observed. A bar of mild steel was stressed and the critical angle before and after stressing was measured. An inverse frequency effect was observed. (auth)

Nuclear Explosions

Refer also to abstract 14753.

14676 (AD-744016) DYNAMIC DUST MEASUREMENTS FOR MIDDLE GUST EVENT II. Final Report. Freeman, Donald; Gibbs, A. H.; Lieberman, Paul; Molmud, P.; O'Neill, J. P. (TRW Systems Group, Redondo Beach, Calif.). 1 Mar 1972. Contract DASA01-71-C-0128. 113p. (DNA-2882-F). NTIS.

Several instrumentation systems were installed at the Crowley Test Site in Colorado to measure the dust lofting parameters associated with passage of the air blast from detonation of a 100-ton sphere of TNT. Dust density history at two elevations was measured with a microwave system. Dust cloud height growth was measured with a high-speed camera system. Particle velocity was measured with impact plates. Initial and final positions of particles and mass lofting efficiency were measured by use of color coded beads. (auth)

14677 (AD-745906) INITIAL RADIATION EXPOSURE FROM NUCLEAR WEAPONS. French, R. L.; Mooney, L. G. (Radiation Research Associates, Inc., Fort Worth, Tex.). 15 Jul 1972. Contract DAHC20-72-C-0123. 87p. (RRA-T-7201). NTIS.

Recent data and methods for predicting the initial radiation exposure at or near the ground surface resulting from the detonation of nuclear weapons were reviewed and evaluated. State-of-the-art methods were then selected or developed for neutron dose, secondary gamma dose from neutron interactions in the air and ground, and fission product gamma dose occurring during the first minute following a detonation. The neutron and secondary gamma method is based on discrete ordinates calculations of neutron transport in an air-over-ground geometry and first-last collision method for source height effects. The fission product gamma model is based on Monte Carlo air transport calculations. (auth)

14678 (AD-746009) EXTENDED ARRAY EVALUATION PROGRAM. SPECIAL REPORT NO. 5. PRELIMINARY EVALUATION OF THE NORWEGIAN LONG PERIOD ARRAY. Eyres, J. S.; Laun, P. R.; Swindell, W. H. (Texas Instruments Inc., Dallas). 30 Apr 1972. Contract F33657-71-C-0843. 165p. (TI-SR-5). NTIS.

Results from the preliminary evaluation of the long-period Norwegian Seismic Array are presented. Signal and noise characteristics, array processing performance, matched and chirp filtering performance, detection threshold estimation, and discriminant behavior are discussed. (auth)

14679 (AD-746683) INTERPRETATION OF SEISMIC MEASUREMENTS TAKEN IN THE DIAMOND MINE SERIES. McLaughlin, R.; Willis, D. E. (Michigan Univ., Ann Arbor. Inst. of Science and Technology). May 1972. Contract F44620-71-C-0033. 89p. (AFOSR-TR-72-1345; DASA-POR-6574). NTIS.

The Geophysics Section of the Infrared and Optics Division of the Willow Run Laboratories has participated in the Mighty Mite series of experiments at the Nevada Test Site by measuring and analyzing near-field seismic phenomena resulting from the events of the series. The results from the Diamond Mine and the Diamond Mine HE shots are discussed in detail, and correlations made between these events and the Diamond Dust Event. (auth)

14680 (AD-747354) SHOCK COMPRESSION AND RELEASE BEHAVIOR OF TWO NEVADA TEST SITE TUFFS. Final Report. Froula, N. H.; Suenaga, E. L.; Bryson, R. L. (Systems, Science and Software, La Jolla, Calif.). Feb 1972. Contract DASA01-71-C-0080. 69p. (DNA-2851-F). NTIS.

The Hugoniot equations of state and several release curves were determined for tuff samples from two underground test sites, Hudson Moon and Diana Mist. Flat plate impact tests were performed on samples in the in-situ state of water saturation. No large difference in the dynamic behavior of the two tuffs was found. An effect is observed when the air-filled-void volume was increased from two to eight percent. A large difference between the dynamic and the quasi-static uniaxial strain curves is observed. At a given stress, the static measurements show about two percent greater compression. (auth)

14681 (AD-747820) OPERATION DANNY BOY EARTH-MOTION MEASUREMENTS. (Army Engineer Waterways Experiment Station, Vicksburg, Miss.). Aug 1964. 68p. NTIS.

The objective of Danny Boy Project 1.2 was to measure ground motion resulting from an underground nuclear detonation in basalt. The measurements obtained from 31 vertically and horizontally oriented accelerometers and 3 vertically oriented velocity meters are presented and analyzed. The accelerometers and velocity meters were placed in the region extending horizontally from 3 to 610 m from surface zero (SZ). All were placed near the surface (i.e., at depths of about $\frac{1}{3}$ m) except the accelerometer at the 3-m station which was buried 18.3 m deep. (GRA)

14682 (AWRE-0-5/73) AN ANALYSIS OF SEISMIC WAVES FROM EARTHQUAKES AND EXPLOSIONS IN THE SINO-SOVIET AREA DURING 1966. Marshall, P. D.; Key, P. F. (Atomic Weapons Research Establishment, Aldermaston (England)). Jan 1973. 34p. Dep. NTIS (U.S. Sales Only). UK 1£.

Discrimination criteria were applied to a set of seismic waveforms originating from seismic disturbances in the Sino-Soviet area. Explosions are identified and attention is drawn to special circumstances in which the $m_b : M_s$ criterion is shown not to work. (auth)

14683 (EERL-Tr-E-72-23) PROJECT TUGBOAT: EXPLOSIVE EXCAVATION OF A HARBOR IN CORAL. Day, W. C. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Feb 1972. 217 p. Dep. NTIS.

A portion of a planned small-boat harbor was explosively excavated in a weak coral material using twelve 10-ton charges of an aluminized ammonium nitrate slurry explosive. This experiment-demonstration was code-named Project Tugboat. The charges were emplaced approximately 36 ft deep in the coral reef which was overlain with a water layer averaging approximately 6 ft in depth. Charges were spaced 100 and 120 ft apart. A series of five calibration tests preceded the main harbor detonations. Apparently because of inadequate boostering, two of the main charges did not fully detonate and one charge deflagrated. An additional array of sixteen ½-ton charges was subsequently emplaced and detonated to clear that portion of the channel. The detonations resulted in a channel varying in width from about 150 to 260 ft at a minimum project water depth of 12 ft. The berthing basin is almost a square area 400 ft on a side at the 12-ft water depth contour. The explosive craters were broad and shallow with no lips and were actually better suited to harbor excavation than the less wide and deeper craters typical of dry land cratering detonations. The cratering mechanism appears to be one of densification of the coral through crushing and subsequent settling. The crater remains devoid of water for several seconds after detonation and then is filled by coral and water as the crater walls fall into the crater. The extent of the crushing action of the detonations was crudely defined by acoustic profiling surveys. Several technical programs were conducted including a wave measurement program, a study of the effect of the detonations on the marine environment, a ground-motion measurement program, a structures response study, an airblast measurement program, and a measurement program to determine the peak pressure and the acceleration and velocity of the water directly over the charge positions. Results of all of these programs are included. (auth)

14684 (EERL-TR-E-72-26) CONSTRUCTION OF NUCLEAR GEOSTORAGE FACILITIES FOR PETROLEUM PRODUCTS. Sprague, K. E. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Jun 1972. 108p. Dep. NTIS.

The feasibility of constructing nuclear explosion cavities to be used as hardened storage facilities for petroleum products in a theater of operations is examined. It is concluded that void volumes of 50,000 to 250,000 barrels, for substitution into the Engineer Functional Component System, could safely and reliably be created at depths of 500 ft/kt^{⅓} with a fission nuclear device of 1 to 10 kt in yield and emplaced in a rotary-drilled hole 18 to 36 in. in diameter. Stored products could be discharged using submersible turbine pumps, hydraulic displacement, or, where terrain allows, gravity flow. Waiting three months after the detonation to inject the petroleum product into the nuclear geostorage container would preclude degradation of critical fuel properties from radiation damage. However, it is not possible to determine the extent of the effects of the thermal, chemical, and physical environment of the chimney on the stored product based on currently available technical information. In order to transform the current state of engineering for nuclear geostorage of petroleum products into usable capabilities that could provide the U. S. Army with the capability of rapidly constructing secure and hardened petroleum storage facilities, experimental evidence is required to demonstrate that the product would be sufficiently free of particulate matter and radioactive contamination and chemical change such that it might be used for its intended purpose. This demonstration could be conducted by a series of test programs using currently available nuclear chimneys less than 1 yr old. The probability of technical attainability is high because the work involved is an extrapolation of current AEC and Corps of Engineer research efforts in the use of nuclear explosives for construction purposes. (auth)

14685 (JABE-DRS-1) DAMAGE SURVEY, SAN FERNANDO EARTHQUAKE OF FEBRUARY 9, 1971. (Blume (John A.) and Associates, Engineers, San Francisco, Calif.). 19 Mar 1971. 87p. Dep. NTIS.

The results of an earthquake damage field survey conducted after the Feb. 9, 1971 San Fernando earthquake are summarized. The survey was performed to collect data regarding earthquake damage or lack of damage to structures, systems, and equipment relatable to nuclear power plant components whose function is safety related. The survey covered dams, embankments, and channels; communication systems; electrical substations, switching and transmission facilities; mechanical and electrical equipment including generators, piping systems, and emergency power generating systems; piping systems; structures including highway overpasses, power houses, tanks, and stacks; and underground utilities and tanks. Recommendations for future analytical studies are presented. (auth)

14686 (LA-5056) ELECTROMAGNETIC PULSE FROM AN UNDERGROUND NUCLEAR EXPLOSION. Miller, L. W. (Los Alamos Scientific Lab., N. Mex). Jan 1973. Contract W-7405-eng-36. 15p. Dep. NTIS.

It is argued that because of earth's high electrical conductivity, the electric current density produced by an underground nuclear explosion becomes approximately solenoidal, i.e., free of electric charges, in a negligibly short time. Therefore, the signal radiated from a simple example of a solenoidal current distribution, a point magnetic dipole with delta function time dependence, located underground, is calculated. The underground signal consists of a magnetic field associated with a much weaker electric field, both of which propagate through the conducting earth in a way that resembles diffusion. The signal is reflected or transmitted at the surface of the ground in a way that depends upon the orientation of the source dipole. It is shown that for a horizontal dipole, a measurable signal could be transmitted to remote points above ground. (auth)

14687 (NVO-746-9) PRELIMINARY SEISMICITY STUDY OF THE SOUTHERN NEVADA REGION FOR THE MONTH OF NOVEMBER 1972. Bayer, K. C. (National Oceanic and Atmospheric Administration, Las Vegas, Nev. Earth Sciences Labs.). Jan 1973. Contract AT(29-2)-746. 19p. Dep. NTIS.

A cooperative (ESL, Sandia Laboratories, and USGS) network of 21 seismic velocity sensitive stations is operated in the southern Nevada area. The most active areas during the month were in Nevada; namely, northeast of Hiko Junction, southeast of Alamo and east of Mercury on both flanks of the Desert Range. Two seismicity maps are included; one of the southern Nevada region and the second of the seismicity on and adjacent to the Nevada Test Site (NTS). (auth)

14688 (NVO-1163-235) INELASTIC/ELASTIC CALCULATIONS OF GROUND MOTION AND PHYSICAL EFFECTS FROM NUCLEAR DETONATIONS IN TUFF. Power, F. W. (Environmental Research Corp., Las Vegas, Nev.). Jan 1973. Contract AT(29-2)-1163. 59p. Dep. NTIS.

Calculations of ground motion from underground nuclear detonations in a wet Nevada Test Site tuff and the same tuff with 5% free porosity added were performed using the one-dimensional inelastic code Workhorse. These calculations were coupled with the elastic wave propagation code Shelp. Preliminary results are presented from a continuing research program to determine the parametrical effect of porosity and water content of tuff on the seismic source function. Results of the inelastic-elastic calculations were compared with corresponding results expected on the basis of the empirically based Mueller-Murphy scaling theory. The calculations and comparisons show that: the peak pressure input to the seismic region is sensitive to the added free porosity, being reduced by about 20%; the peak displacements and spectral amplitudes calculated from Shelp are reduced by 40% due to the added free porosity, implying a decrease in seismic coupling efficiency; and the spectral ratios indicate that a decrease in steady state stress and consequently a decrease of the long period spectral components occur with increase in free porosity. These results suggest that adjustments of the permanent stress for porosity may be very important when making ground motion predictions using the Mueller-Murphy scaling theory. (auth)

14689 (SC-RR-720363) FACTORS AFFECTING SMALL PROBABILITIES OF DAMAGE TO BUILDINGS BY EARTH MOTION. Ellett, D. M. (Sandia Labs., Albuquerque, N. Mex.). Jan 1973. 66p. Dep. NTIS.

Assuming that the ground motion can be described as lognormally distributed about a mean value, the effects of various assumptions concerning the capacity of a building to resist ground motions are examined. In accomplishing this, the distributions used to describe capacity are described and plotted, then graphs of probability of demand exceeding capacity versus normalized distance are shown. At distances where the probabilities are small, the strongest influence on the results is the behavior near zero of the distributions used to describe the capacity of buildings to resist damage. The variability of building strengths also has a strong influence. The variability of ground motion has somewhat less influence. The implications of this study are reviewed and recommendations for further work are included. (auth)

14690 (STI/PUB-300(Vol.7)) PEACEFUL USES OF ATOMIC ENERGY, VOLUME 7. Proceedings of the Fourth International Conference, Geneva, 6-16 September 1971. (International Atomic Energy Agency, Vienna (Austria)). 1972. 542p. (In several languages). (CONF-710901-(Vol.7)). IAEA $14.00.

Thirty-six papers on the following subjects are included in this volume: advanced research uses of reactors and accelerators and applications in energy conversion; uses of nuclear explosives in civil engineering and mineral resources development; nuclear propulsion systems for ships and space vehicles; nuclearly fueled energy conversion systems for electric power generation; pros-

pects of controlled thermonuclear reactions; and production and uses of transuranium and super-heavy isotopes. (LCL)

14691 (UCID-15696) ARPA-AEC SEISMIC/EVASION RESEARCH PROGRAM: PROGRESS ON SMALL-SCALE HE EXPERIMENTS AND COMPUTER-CODE VERIFICATION. Rodean, H. C.; Larson, D. B.; Hearst, J. R.; Brown, S. R. (California Univ., Livermore. Lawrence Radiation Lab.). 27 Jul 1970. 17p. Dep. NTIS.

The basic objective of the Seismic/Evasion Research Program at LRL is to obtain a solution to the general coupling problem. In principle, calculations using material properties and explosion yield can provide the information needed to satisfy this objective. However, without experimental verification of the validity of the descriptions of materials there can be no significant level of confidence in such calculations. The goal of the small-scale HE experiments is to provide this experimental verification and thus to establish a proven method for predicting the seismic coupling efficiency of any material. The development of a gage for monitoring stress history and/or particle-velocity history for use in experiments using plane and spherical one-dimensional geometry and the development of a spherical HE source are discussed. (auth)

14692 (UCID-15788) ARPA-AEC SEISMIC/EVASION RESEARCH PROGRAM: PROGRESS ON SMALL-SCALE HE EXPERIMENTS AND COMPUTER-CODE VERIFICATION, JULY-DECEMBER 1970. Rodean, H. C.; Larson, D. B.; Hearst, J. R.; Brown, S. R. (California Univ., Livermore. Lawrence Radiation Lab.). 20 Jan 1971. 27p. Dep. NTIS.

The successful use of a particle velocity gage in both one-dimensional plane and one-dimensional spherical geometries in seismic coupling studies is presented. The agreement between calculations and experimental data using this velocity gage in spherical geometry is presented for Plexiglas experiments to illustrate the importance of including dynamic unloading states in the equation-of-state description used in these calculations. Also presented are the progress in equation-of-state measurements, the success in a continuing effort to develop a stress gage to complement the particle velocity gage, and the progress in defining spherical sources for future applications. (auth)

14693 (UCID-15948) ARPA-AEC SEISMIC/EVASION RESEARCH PROGRAM: PROGRESS ON SMALL-SCALE HE EXPERIMENTS AND COMPUTER-CODE VERIFICATION, JANUARY-NOVEMBER 1971. Larson, D. B.; Rodean, H. C.; Spataro, S. J.; Hearst, J. R. (California Univ., Livermore. Lawrence Livermore Lab.). 19 Nov 1971. Contract W-7405-eng-48. 30p. Dep. NTIS.

A program was undertaken to determine the material properties that control seismic coupling efficiency and to use this information to solve the general coupling problem. Experimental and calculational results are presented for Plexiglas, which was the medium chosen for use in checking the techniques. The progress in the development of a stress-history gage is discussed. Dynamic equation-of-state measurements and the results of spherical HE experiments in various earth media are also presented. (auth)

14694 (UCID-16061) ARPA-AEC SEISMIC/EVASION RESEARCH PROGRAM: PROGRESS ON SMALL-SCALE HE EXPERIMENTS AND COMPUTER-CODE VERIFICATION, NOVEMBER 1971-JULY 1972. Larson, D. B.; Rodean, H. C.; Spataro, S. J. (California Univ., Livermore. Lawrence Livermore Lab.). 28 Jul 1972. Contract W-7405-eng-48. 36p. Dep. NTIS.

Experimental evidence is presented which indicates that dolomite decouples, relative to granite, because of a much lower "elastic" yield point. Ice at -10°C is shown to be a good decoupler, and apparently the addition of soil enhances this decoupling. The addition of water to saturate a porous medium is shown to greatly reduce the hysteresis in the loading-unloading cycle and to also greatly reduce material strength, especially at higher confining pressures. (auth)

14695 (UCRL-51303) EXPLOSIVE STIMULATION OF A GEOTHERMAL STEAM RESERVOIR. Sherwood, A. E. (California Univ., Livermore. Lawrence Livermore Lab.). Nov. 1972. Contract W-7405-eng-48. 14p. Dep. NTIS.

A mineral deposition model is proposed to explain the production decline from geothermal wells producing dry (superheated) steam. The model is based on isothermal mineral deposition caused by a pressure gradient near the well. Using reasonable parameter values, the model approximates the production behavior of a typical well at The Geysers field in California. The predicted effect of explosive fracturing on steam-well production and economics is discussed; the prediction shows that, in a well with a 4-ft fracture radius, the production of steam can be increased by a factor of 6 over 20 years. (auth)

14696 (USGS-474-125) TOPOGRAPHIC AND ISOBASE MAPS ON THE CANNIKIN SINK, AMCHITKA ISLAND, ALASKA. Morris, R. H. (Geological Survey, Denver, Colo.). Feb 1973. Contract AT(29-2)-474. 8p. Dep. NTIS.

A topographic map of part of the Cannikin sink area has been compiled by use of photogrammetric techniques. By comparison of the preshot topographic map with the postshot topographic map an isobase map was compiled. It shows that the maximum subsidence of the sink was about 40 feet and that the shape of the sink is controlled, in part, by three principal directions of faulting. (auth)

14697 NON-SEISMIC DETECTION OF UNDERGROUND NUCLEAR TESTS. pp 437-460 of World Armaments and Disarmament. Stockholm; Almqvist and Wiksell (1972).

Statements implying a present role of satellites or of electronic intelligence (ELINT) in underground nuclear test detection and identification are examined, as well as methods that are theoretically possible for underground test detection by satellites. Publicly available information on ground-based and satellite-borne detection methods for nuclear weapons tests that might be conducted in space or in the atmosphere is summarized. The Vela satellite program is described. (Sweden)

14698 NUCLEAR EXPLOSIVE METHOD FOR STIMULATING HYDROCARBON PRODUCTION FROM PETROLIFEROUS FORMATIONS. Nordyke, M. D. (to United States Atomic Energy Commission). U. S. Patent 3,688,843. 5 Sep 1972. Filed 16 Nov 1970.

Multiple nuclear explosive devices are emplaced and detonated sequentially at spaced locations in a borehole in a petroliferous formation. The explosive size, relation spacings, depths of burial and sequential timing are selected and arranged to minimize and limit seismic surface effects as well as to optimize fracturing of the formation with consequent more economical stimulation of petroleum hydrocarbon especially in low-permeability reservoirs. (Official Gazette)

Protective Structures and Equipment

14699 (ORNL-4849) BLAST SHELTER POTENTIAL IN NEW GOVERNMENT BUILDINGS. FINAL REPORT. Cristy, G. A. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 247p. Dep. NTIS.

A survey was made of the building programs of the major federal agencies to locate and identify below-ground floor space in buildings while they were in the design or early construction phase. Data were collected and analyzed to evaluate the potential for upgrading the federal civil defense shelter program through blast slanting of all new government buildings. The criterion assumed for blast slanting was protection from initial effects from a one megaton weapon with no blast closure provided. Initial effects were to include blast, thermal and initial nuclear radiation at the 15 psi overpressure region. Assuming that the building programs of the federal agencies for the next decade would follow the same pattern that existed the last five years as regards location, size, and type of construction, and assuming all underground floor space could be blast slanted for $60 per shelter space, the result would be the production of only three-fourths of a million blast shelter spaces during the decade. This represents a differential cost of four and one-half million dollars per year. This cost is less than one percent of the federal building construction budget each year. The survey assembled and displayed data on geographic location, construction cost, and blast slantable spaces in 87 federal government buildings being designed and/or built by the General Services Administration, the Veterans Administration, and the Atomic Energy Commission. The geographic locations of these buildings were examined in comparison with data from previous studies. It was found that except for a few locations in the center of very large cities, the potential shelter spaces in federal buildings located by this survey would provide shelter space to populations that would not already have been provided blast shelter space by the earlier proposed programs of utilizing PV 71-81 shelters and blast slanting of transportation structures. (auth)

14700 EFFECTS OF DEPRESSING ATTACHMENT RATION OF RADON DAUGHTERS IN URANIUM MINE ATMOSPHERE. Shreve, J. D. Jr.; Cleveland, J. E. (Kerr-McGee Corp., Oklahoma City, OK). Amer. Ind. Hyg. Ass. J.; 33: No. 5, 304-314 (May 1972).

The diffusion coefficient of particles 5 to 8 Å in diameter—primary radon daughters, for instance—is roughly 100 times that for condensation nuclei (200 to 1000 Å in diameter) to which radon daughters normally attach. This difference should manifest itself as a measurable increase in daughter deposition on uranium mine walls were condensation nuclei previously removed by

air filtration. An account of experiments done to quantify the degree to which this simple air treatment might make a mine atmosphere self-ridding of radon daughters is reported. Experimental results indicate that airborne RaA can be kept to less than 50% and RaC taken to less than 30% of concentrations they would grow to otherwise. Practical applications are not immediately obvious. However, in time and with engineering ingenuity the power of the filtration technique may be brought to bear on secondary ventilation problems. (auth)

Safety Engineering

14701 (COO-3153-97) PENULTIMATE STATIC PRESSURE CONTAINMENT. Ruoff, A. L. (Edsel B. Ford Inst. for Medical Research, Detroit, Mich. Div. of Nuclear Spectroscopy and Radiation Physics). 1972. 13p. (CONF-720803-7). Dep. NTIS.

From Cryogenic engineering conference; Boulder, CO (9 Aug 1972).

When the pressure dependence of the yield stress, which manifests itself through the pressure dependence of the elastic constants is taken into account, it is predicted that pressures of about 2 Mbars can be contained using steel or sintered tungsten carbide. (auth)

Vacuum Engineering

Refer also to abstracts 14654 and 15398.

14702 INVESTIGATION ON TRITIUM CONTAMINATION OF TITANIUM ION-GETTER PUMPS. Biro, J. (MTA Kozponti Fizikai Kutato Intezete, Budapest). Izotoptechnika; 15: No. 6, 349-53(Jun 1972). (In Hungarian).

Information and data are presented on tritium activity in pumps for neutron generators and on procedures for handling and reconditioning of contaminated pumps. (JRD)

14703 VACUUM LOCK. Dmitruk, M. I.; Runov, A. D. (Inst. of Atomic Energy, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 485-487(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 154-156(1972).

A vacuum lock is described in which the axis of the circulation aperture, having a diameter of 900 mm, is vertical. The special feature of the construction is the use of the weight of the plate as the force which presses the plate and the rubber washer against the seat. The plate rises and falls in the vacuum when the lock is opened and closed by a compact mechanism with which the plate is coupled by two cables. (auth)

14704 VACUUM TECHNOLOGY MEETING. Conference Held at Versailles, France, May 30, 1972. Vide; No. 157, Suppl., 1-304(1972). (In several languages). (CONF-720572).

Various pumping methods (ionic, molecular, cryogenic) are reviewed together with their advantages and the way they are used. Methods for measuring vacuums and ultrahigh vacuums and for analyzing residual atmospheres are also given. Fourteen of the 41 articles presented are separately indexed. (France)

For abstracts of individual papers see: 14654, 14705–14709, 14960, 15397–15399, 15458–15460, and 15472.

14705 IMPROVEMENTS TO THE EFFICIENCY OF TURBOMOLECULAR PUMPS. Henning, J. Vide; No. 157, Suppl., 38-44(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

The pumping speeds of turbomolecular pumps can be increased by reducing the losses occurring in the joints between the pumps and the evacuated enclosures. The final pressure can be further reduced by additional ultra high vacuum pumping devices. (France)

14706 DEVELOPMENT OF A VACUUM CHAMBER FOR SIMULATING THE IONOSPHERIC PLASMA. UTILIZATION OF LIQUID HELIUM CRYOGENIC PUMPING. Arnal, Y. (CNRS, Saint-Maur-des-Fosses, France). Vide; No. 157, Suppl., 81-8 (1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

A description of the installation is presented. The pressure-drop/time curve and the degassing rate are given. The performance of the pumping unit when the plasma source is operating is also presented. The liquid helium consumption rate is stated. (France)

14707 CRYOPUMPING OF HYDROGEN AND HELIUM. Boissin, J. C. (L'Air Liquide, Sassenage, France); Thibault, J. J.; Richardt, A. Vide; No. 157, Suppl., 103-10(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

It was demonstrated that the use of argon cryodeposits can extend the utilization of liquid helium cryopumps to the pumping of helium and hydrogen. The flux pumped (10^{-2} t/l/s), the total quantity of gas pumped (50 t/l for He and 400 t/l for H_2) and the pumping speeds measured are such that cryopumps operating at 4.2°K can pump hydrogen and helium without the use of additional pumping. (France)

14708 ANALYSIS AND IMPROVEMENTS TO THE PERFORMANCE OF PENNING GAGES. Tallon, J. (CIT-Alcatel, Annecy, France). Vide; No. 157, Suppl., 175-81(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

Penning ionization gages are discussed: sensitivity, extension of the working range, accuracy, and stability. The protection of such gages against pollution was studied. (France)

14709 CRYOGENIC PUMPING. Hobson, J. P. (National Research Council of Canada, Ottawa). Vide; No. 157, Suppl., 201-13(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

The general principles of the operation of cryogenic pumps are exposed together with the adsorption and desorption phenomena taking place at the different surfaces. The pumps are classified according to five different categories: bare surface pumps, free adsorbant pumps, bound adsorbant pumps, solid gas pumps, and condensation pumps. (France)

14710 ULTRAHIGH VACUUM MEASURING BY MEANS OF HOT-CATHODE IONIZATION GAGES. Neuman, J. (TESLA, Prague). Slaboproudy Obz.; 33: 35-39(Jan 1972). (In Czech).

The lower limit of application of the conventional Bayard–Alpert gage, which is approximately 10^{-10} torr, is shown to be determined by ion current components independent of pressure. The factors influencing these components are reviewed. Features of some new types of gages and vacuometers are described. (IAA)

ENVIRONMENTAL AND EARTH SCIENCES

14711 ENVIRONMENTAL QUALITY AND SAFETY. CHEMISTRY, TOXICOLOGY, AND TECHNOLOGY. VOL. I. GLOBAL ASPECTS OF CHEMISTRY, TOXICOLOGY, AND TECHNOLOGY AS APPLIED TO THE ENVIRONMENT. Coulston, F.; Korte, F. (eds.). New York; Academic Press, Inc. (1972). 278p. $18.00.

The first in a series of publications combining features of a journal, a series, a periodical, and monographs is presented. It is to appear under the general heading Environmental Quality and Safety. Twenty one articles are included in this volume. A separate abstract was prepared for one article selected as being in the scope of NSA. (JRD)

For an abstract of an individual section see: 14746.

Minerals and Ores

Refer also to abstract 15316.

14712 (BARC/I-162) ACTIVITY BUILDUP OF NATURALLY OCCURRING RADIOACTIVE MATERIALS. PART I. Gopinath, D. V.; Singh, Hari (Bhabha Atomic Research Centre, Bombay (India)). 1972. 49p. INIS.

Detailed computations for the activity and energy buildup in five important systems, i.e., natural uranium, natural thorium, radium, radon and thoron are reported. The salient features of the activity buildup apparent from the calculated data in these groups are discussed. Special reference is made to the activity and energy buildup in thorium obtained from the Indian monazite ore as the radiometric behavior of the thorium obtained from this ore happens to be different from that of natural thorium owing to the presence of small amounts of uranium in the ore. (INIS)

14713 (NP-19627) URANIUM EXPLORATION IN QUEENSLAND, 1967-71. Report No. 69. Brooks, J. H. (Geological Survey of Queensland (Australia)). 1972. 22p. Dep. NTIS (U. S. Sales Only).

Exploration for uranium revived in 1967 after a period of little activity, and a peak was reached in 1970, when drilling for uranium totalled 143,920 feet, and numerous airborne and ground radiometric surveys were carried out. Total Queensland reserves of U_3O_8, in ore with a grade exceeding 2lb/ton, are estimated to be 28,926 short tons. Increases in reserves in the 1967 to 71 period resulted largely from further exploration of previously known deposits in the Precambrian of northwestern Queensland. The largest deposits are in the Westmoreland area, but the only firm plans for production of uranium are at the Mary Kathleen deposit, which is to recommence production in 1974. Extensive exploration for sedimentary uranium deposits, mainly in Jurassic and Cretaceous sequences, has not been successful, but there is considerable scope for further exploration. (auth)

14714 (TID-26252) AEC OPEN-FILE REPORTS ON NUCLEAR RAW MATERIALS. (Division of Production and Materials Management (AEC), Washington, D. C.). Jan 1973. 11p. Dep. NTIS.

14715 (TID-26253) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN ALASKA. (Division of Production and Materials Management (AEC), Washington, D. C.). Nov 1972. 4p. Dep. NTIS.

14716 (TID-26254) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN ARIZONA. (Division of Production and Materials Management (AEC), Washington, D. C.). Jan 1973. 9p. Dep. NTIS.

14717 (TID-26255) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN CALIFORNIA, NEVADA, OREGON, AND WASHINGTON. (Division of Production and Materials Management (AEC), Washington, D. C.). Dec 1972. 10p. Dep. NTIS.

14718 (TID-26256) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN COLORADO. (Division of Production and Materials Management (AEC), Washington, D. C.). Dec 1972. 17p. Dep. NTIS.

14719 (TID-26257) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES ON THE COLORADO PLATEAU. (Division of Production and Materials Management (AEC), Washington, D. C.). Jan 1973. 12p. Dep. NTIS.

14720 (TID-26258) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN IDAHO AND MONTANA. (Division of Production and Materials Management (AEC), Washington, D. C.). Jan 1973. 12p. Dep. NTIS.

14721 (TID-26259) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN NEW MEXICO. (Division of Production and Materials Management (AEC), Washington, D. C.). Jan 1973. 9p. Dep. NTIS.

14722 (TID-26260) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN NORTH AND SOUTH DAKOTA. (Division of Production and Materials Management (AEC), Washington, D. C.). Nov 1973. 10p. Dep. NTIS.

14723 (TID-26261) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN THE CENTRAL U. S. (ARKANSAS, IOWA, KANSAS, LOUISIANA, MISSOURI, NEBRASKA, OKLAHOMA, TEXAS). (Division of Production and Materials Management (AEC), Washington, D. C.). Nov 1972. 11p. Dep. NTIS.

14724 (TID-26262) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN THE NORTHEAST AND CENTRAL U. S. (ILLINOIS, INDIANA, MICHIGAN, MINNESOTA, NEW ENGLAND, NEW JERSEY, NEW YORK, OHIO, PENNSYLVANIA, AND WISCONSIN). (Division of Production and Materials Management (AEC), Washington, D. C.). Dec 1972. 7p. Dep. NTIS.

14725 (TID-26263) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN THE SOUTHEASTERN UNITED STATES (ALABAMA, DELAWARE, DISTRICT OF COLUMBIA, FLORIDA, GEORGIA, KENTUCKY, MARYLAND, MISSISSIPPI, NORTH AND SOUTH CAROLINA, TENNESSEE, VIRGINIA, AND WEST VIRGINIA). (Division of Production and Materials Management (AEC), Washington, D. C.). Nov 1972. 10p. Dep. NTIS.

14726 (TID-26264) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN UTAH. (Division of Production and Materials Management (AEC), Washington, D. C.). Jan 1973. 17p. Dep. NTIS.

14727 (TID-26265) SELECTED BIBLIOGRAPHY ON RADIOACTIVE OCCURRENCES IN WYOMING. (Division of Production and Materials Management (AEC), Washington, D. C.). Jan 1973. 12p. Dep. NTIS.

14728 SEDIMENTARY TYUYAMUNITE DEPOSITS IN THE DERA GHAZI KHAN DISTRICT, WEST PAKISTAN. Rahman, M. A. (Atomic Energy Minerals Centre, Lahore). Nucleus (Karachi); 9: No. 1-2, 33-7(1972).

The uranium mineral tyuyamunite occurs in sandstones of Middle Siwalik (Upper Miocene) age in the Dera Ghazi Khan district of West Pakistan. The tyuyamunite is irregularly distributed in lenses and layers throughout a stratigraphic thickness of 45 meters. Microscopically, it occurs as pellicles on detrital grains and in the matrix of the sandstones. Field study, as well as petrographic analysis and x-ray radiography of the sandstones, suggest that the tyuyamunite occurrence is of sedimentary origin. (auth)

14729 GAMMA-RAY ATTENUATION COEFFICIENT MEASUREMENTS FOR DIFFERENT ROCKS. Holmberg, P.; Riepo, R. (Oulu Univ., Finland). Geophysica; 12: No. 1, 81-90(1972).

Total gamma-ray attenuation coefficients have been measured in the energy range 0.3 to 1.8 MeV for the following rocks: gabbro, anorthosite (two types), amphibolite and a sample of ilmenite-magnetite ore. The values obtained were in good agreement with the theoretically evaluated coefficients. (auth)

14730 DEPLETION IN LOW-GRADE URANIUM ORE EXPLOITATION. Halik, L.; Kubecek, J. (Uranium Mines, Doini Rozinka, Czech.). Rudy (Prague); 19: No. 12, 356-8(Dec 1971). (In Czech).

The calculation of depletion in the mining of low-grade uranium ores is described aimed at reducing the amount of waste rock. An example is given of its application in overhand scoping. (WSA of Czech)

14731 YADERNO-GEOFIZICHESKIE METODY. (Nuclear Geophysical Methods). Zaitseva, I. P. (ed.). Novosibirsk, USSR; Izdatel'stvo Nauka Sibirskoe Otdelenie (1972). 384p.

This book consists of a collection of 61 papers by different authors and covers the subjects of geophysical prospecting by

gamma methods, neutron methods, and apparatus such as gamma spectrometers, cavity meters, neutron borehole radiometers, and small neutron generators for high-temperature boreholes. The gamma–gamma methods include borehole well logging, densimeters, photo-neutron methods of determination of certain elements, and gamma-resonance methods for cassiterite. The neutron methods include activation analysis of V, F, B, and neutron–neutron methods for determining Ag, Au, B, and other absorbing and scattering elements. (KSW)

14732 GEOLOGIYA POSTMAGMATICHESKIKH TORIEVO-REDKOMETAL'NYKH MESTOROZHDENII. (Geology of Post-Magmatic Thorium-Rare Metal Deposits). Nevskogo, V. A. (ed.). Moscow; Atomizdat (1972). 408p.

The author offers a classification of the genetic types of post-magmatic thorium-rare metal ore deposits and discusses the geological conditions of their formation. Ore-bearing magmatic deposits and peculiarities in their structure, and the geochemistry of rare earths and the radioactive elements attending them are examined. Attention is given to ore-bearing carbonatite complexes, the processes which occurred in their formation, and the industrial concentration of useful minerals from these complexes. A number of sub-groups of pneumato-hydrothermal deposits are discussed at length: albitite deposits (Th-Ta-Zr-RE, Th-Zr-RE-Nb, Th-RE-Zr-Be, etc.), deposits of contact cherts (RE-U-Nb-Th, and Th-RE high-temperature deposits), and carbonate rocks such as skarn. This is followed by a discussion of a number of high-temperature hydrothermal deposits (Nb-Th-RE, Th-U, U-Th-RE-Mo, RE-W-Sn, and Fe-Th-RE-Zn ore bodies). The final chapter focuses attention on average-temperature and low-temperature hydrothermal deposits (Pb-Zn-Th, RE-Th, Cu-Th-RE, U-Th, Th-U, and RE-Th-U deposits). In the above listings, RE = rare earths. (170 references) (KSW)

14733 WORLD URANIUM SUPPLIES. pp 470-482 of World Armaments and Disarmament. Stockholm; Almqvist and Wiksell (1972).

The potential demand for uranium and available supplies are examined. A background of the military demand in the 1950's which brought a large supplying industry into being is presented. The demand for uranium for electrical power generation has been slow to emerge, currently there is a state of over-supply in the uranium market. Yet this picture is very likely to change as the generation of electric power becomes based on nuclear stations. (Sweden)

14734 URANIUM IN AUSTRALIA. South, S, A. (Australian Atomic Energy Commission, Lucas Heights). At. Energy Aust.; 15: No. 4, 15-30(Oct 1972).

Uranium mineralization in Australia is described, with emphasis on the Rum Jungle-Alligator Rivers, Westmoreland-Mary Kathleen, and Mt. Painter-Radium Hill regions. (Australia)

14735 OPREDELITEL' MINERALOV URANA I TORIYA. (Identification of Minerals of Uranium and Thorium). Bur'yanova, E. A. Moscow; Izdatel'stvo Nedra (1972). 52p.

The minerals of U and Th were classified as oxides, carbonates, sulfates, molybdates, phosphates, arsenates, vanadates, silicates, and several minor classes for the purpose of listing in tabular form together with their compositions and synonyms. Identification tables comprise the major portion of the book, and arrange the minerals of U and Th primarily as to their solubility characteristics in various acids. Crystal habit, hardness, specific weight, luster, streak, color and other optical properties are listed as additional aids to identification. (76 references) (KSW)

14736 SEARCH FOR ^{244}Pu TRACKS IN MOUNTAIN PASS BASTNAESITE. Fleischer, R. L. (General Electric Co., Schenectady, NY); Naeser, C. W. Nature (London); 240: No. 5382, 465(22 Dec 1972).

Reference is made to Hoffman (Nature 234: 132(1971)) who reported observation of ^{244}Pu in nature in bastnaesite-rich ore from Mountain Pass, California, raising questions as to whether the ^{244}Pu could represent not primordial matter but later inflow of cosmic matter before formation of the Mountain Pass deposit. The present authors found that the bastnaesite has an apparent Cretaceous fission track age and does not show any anomalous fission tracks due to ^{244}Pu. Hence fission tracks cannot provide any support for the findings of Hoffman. (UK)

Radioactive Effluents

Refer also to abstracts 14745, 16616, 16626, and 16678.

Radioactivity Monitoring and Transport

Refer also to abstract 14628.

14737 (BARC/I–161) ENVIRONMENTAL RADIOACTIVITY AT TARAPUR ATOMIC POWER STATION SITE DURING 1969–1970. Bhat, I. S.; Khan, A. A.; Viswanathan, E. K.; Chandramouli, S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 74p. INIS.

Environmental sampling and measurements conducted by the Environmental Survey Laboratory (ESL) at Tarapur, India, during 1969 to 1970 are reported. Results of analyses of liquid radwaste samples indicate that radioiodine is the major activity released to sea and radiocesium the next higher activity. Thus, the analysis is mainly for ^{137}Cs and ^{131}I and at times for ^{90}Sr and ^{89}Sr. Contamination has been detected as far as 16 km from the coast. The suspended silt beta and gamma activity is measured and it has been found that the main radionuclides are ^{58}Co, ^{60}Co, ^{131}I, ^{137}Cs, ^{134}Cs, and ^{54}Mn. The levels of ^{131}I and ^{137}Cs found in fish, and sea weeds, are less than the accepted maximum permissible levels of concentration. Terrestrial analysis is done by collecting air samples periodically both at plant site, and at the colony and analyzing them for ^{90}Sr, ^{89}Sr and ^{137}Cs. The monthly fallout samples at the Tarapur housing colony have been analyzed for ^{90}Sr, ^{89}Sr, ^{137}Cs, ^{140}Ba, and ^{106,103}Ru. Levels of ^{131}I in banana leaves, goat thyroid and ^{90}Sr and ^{137}Cs in grass are also studied. Vegetables are grown in farms near plant site and they are also analyzed for ^{90}Sr and ^{137}Cs. Soil and silt samples have been processed and analyzed for long-lived fission products such as ^{90}Sr and ^{137}Cs and radium, by acid leaching. All the levels measured in and around Tarapur plant show that they are all well within the safety limits prescribed by international standards. (auth)

14738 (HASL–268) FALLOUT PROGRAM. Quarterly Summary Report, September 1, 1972–December 1, 1972. Hardy, E. P. Jr. (Health and Safety Lab. (AEC), New York). 1 Jan 1973. 179p. Dep. NTIS.

Six papers on HASL activities during 1971 and 1972 in fallout monitoring at worldwide sites are presented. A separate abstract was prepared for each paper. (L.C.L.)

For abstracts of individual papers see: 14739–14741, 14747, 14748, and 14751.

14739 (HASL–268, pp I.24-49) ANALYSES OF QUALITY CONTROL SAMPLES AT HASL AND A CONTRACTOR LABORATORY DURING 1972. Hardy, E. 1 Jan 1973.

In Fallout program. Quarterly summary report, September 1, 1972–December 1, 1972.

Samples of biological material and fallout, analyzed at HASL and by a contractor laboratory include quality control samples which are submitted as blinds. These checks consist of blanks, reference samples analyzed repeatedly over a period of years, replicates or splits of unknowns, spikes, and duplicate samplings. Quality control data for ashed bone, diet, tapwater, and fallout samples analyzed for ^{90}Sr, ^{137}Cs, and Ca during 1972 are summarized. (auth)

14740 (HASL–268, pp I.50-70) FALLOUT TRITIUM IN THE ENVIRONMENT AND THE DOSE COMMITMENT. Bennett, B. G. 1 Jan 1973.

In Fallout program. Quarterly summary report, September 1, 1972–December 1, 1972.

Tritium produced in weapons testing and dispersed throughout the environment caused substantial increases in tritium concentrations in surface waters, in drinking water, food, and in man, though rather steady declines have been observed since the Test Ban Treaty was signed in 1963. The contribution of tritium to the total fallout dose commitment is relatively minor compared to other radionuclides, but the anticipated widespread tritium releases from nuclear power facilities had prompted this rather careful evaluation of the dose commitment from weapons-produced tritium. The record of variations in surface water tritium concentrations was constructed from the available data. This environmental tritium level is related to daily tritium intake by man. A three compartment model is used to describe the retention of tritium in loose water and in bound organic form in the body, from which the dose is determined. The dose commitment from fallout tritium based on average environmental tritium levels in the U. S. is 1.5 mrad. (auth)

14741 (HASL–268, pp III.1-30) DATA FROM SOURCES OTHER THAN HASL. 1 Jan 1973.

In Fallout program. Quarterly summary report, September 1, 1972–December 1, 1972.

Fallout data from worldwide sources other than HASL are presented and include: 1972 Ispra data on radioactivity in ground-level atmosphere and fallout content in atmospheric precipitation; and New Zealand Dept. of Health data on 1972 monitoring of atmospheric precipitation in New Zealand and on Pacific Islands, the effects of French nuclear tests conducted during 1972 in the South Pacific, total beta activity in ground-level atmosphere and in rainwater, and the ^{131}I content in milk. (LCL)

14742 (HASL-268(App.)) APPENDIX TO HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM QUARTERLY SUMMARY REPORT (SEPTEMBER 1, 1972 THROUGH DECEMBER 1, 1972). (Health and Safety Lab. (AEC), New York). 1 Jan 1973. 480p. Dep. NTIS.

Tabulated data are presented on: ^{89}Sr and ^{90}Sr in monthly deposition at world land sites during 1957 to 1973; ^{90}Sr deposition at Atlantic Ocean weather stations during 1965 to 1973; 1963 to 1973 measurements at 32 Naval Research Laboratory stations of the gross gamma activity and content of ^{7}Be, ^{109}Cd, ^{141}Ce, ^{144}Ce, ^{137}Cs, ^{55}Fe, ^{54}Mn, ^{238}Pu, ^{239}Pu, ^{89}Sr, ^{90}Sr, ^{95}Zr, and stable lead in surface air; ^{90}Sr content in New York City milk and tap water during 1954 to 1973, and the $^{137}Cs/^{90}Sr$ ratio in New York City tapwater during 1965 to 1973. (LCL)

14743 (KFK-1661) PLACE DEPENDENT DOSE OF ^{131}I. Bayer, A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik). Aug 1972. 33p. (In German). Dep. NTIS (U. S. Sales Only).

For continuous emission of iodine-131 the space-dependent specific doses are calculated for various ages. The source at 100m height is situated in the middle of an area having a radius of 100 km, in which raw milk is delivered to a dairy plant. A mixture of 80% normal weather and 20% inversion weather is assumed and deposition processes are taken into account. The radiological burden is calculated on the basis of the air intake and milk consumption, a distinction is made between central-milk-supply and self-supply. The most endangered group are infants up to one year of age fed with self-supplied milk in the neighborhood of the reactor. With a specific dose of 4×10^{-2} Rem/Ci and a maximum permissible thyroid dose of 90 mRem/a applicable to this age group, the maximum emission rate must be limited to 2 Ci/a. During the period of greenstuff feeding the maximum limit is 1 Ci/a. The model used is discussed. (auth)

14744 (NIRS-RSD-35) RADIOACTIVITY SURVEY DATA IN JAPAN. Number 35. (National Inst. of Radiological Sciences, Chiba (Japan)). May 1972. 29p. Dep. NTIS (U. S. Sales Only).

Data are reported on ^{90}Sr and ^{137}Cs contents in standard and total diets in Japan for the periods May to Nov. 1971, June to Nov. 1971, and May to Dec. 1971 and in seawater, bottom of sea soil, fish, shells, and sea weeds for the period May to Dec. 1971 and in sea weeds, shells, and fish for the period May 1971 to Jan. 1972. (PCH)

14745 TECHNOLOGY AND ECOLOGY: IS THERE A NEED FOR CONFRONTATION? Weinberg, A. M. (Oak Ridge National Lab., TN). Bioscience; 23: No. 1, 41-5(Jan 1973).

A general discussion of technological problems in relation to the environment is presented. It is pointed out that non-polluting technologies are coming into being, and hyperfiltration and nuclear power are discussed as examples. Two methods of removing waste by hyperfiltration, high-pressure filtration and cross-flow filtration, are described. Evidence is presented that nuclear power, if properly operating, has less effect on the environment than coal-burning power plants except for the dissipation of heat and that the release of radioactivity from a properly operating nuclear power plant is very small. Potential impacts of reactors on the environment are: reactor accidents, accidents during transport of radioactive materials, and malfunction of waste disposal systems. The importance of careful handling of the apparatus of nuclear power is emphasized. The significance of the National Environmental Policy Act of 1969 is discussed. A consequence of this act is the requirement of Environmental Impact Statements for each proposed construction of a reactor. It is emphasized that these statements can have important and beneficial effects on both ecology and technology. Examples of these statements and their effects are described. (HLW)

14746 CURRENT AND FUTURE ENVIRONMENTAL PROBLEMS ARISING FROM ENERGY CONVERSION. Hasserodt, U. (Deutsche Shell AG, Hamburg). pp 28-40 of Environmental Quality and Safety. Chemistry, Toxicology, and Technology. Vol. I. /Coulston, F. (ed.). New York; Academic Press, Inc. (1972).

A general survey of the present state of developments in environmental problems arising from energy conversion is presented and a forecast is given up to 1980. Primary consideration is given to the situation in the Federal Republic of Germany and the discussion is restricted only to environmental protection problems connected with the generation of heat and electric power in stationary units. Data are presented on the trend of emission of sulfur dioxide by combustion of various types of fuel (and coal) in industrial and domestic use and possible technologies for further reduction of these emissions are discussed. Emission in the form of dust from combusting fuels and pollutants resulting from incomplete combustion is not regarded as a significant problem since they can be eliminated by using available equipment and proper combustion conditions. There is an upward trend of nitrogen oxides being emitted in Germany. Additional steps for reduction are to be taken, but further information on the behavior of nitrogen oxides in the atmosphere is necessary. Additional problems may arise from the gaseous radioactive waste products of nuclear power generation, and the waste heat, the latter due to higher individual capacity as compared to plants using fossil fuels. (auth)

Atmosphere

14747 (HASL-268, pp I,2-16) HASL SURFACE AIR SAMPLING PROGRAM: THE QUALITY OF ANALYSIS, 1971. Toonkel, L. E.; Volchok, H. L. 1 Jan 1973.

In Fallout program. Quarterly summary report, September 1, 1972-December 1, 1972.

In general the quality of the radiochemical analyses and the gamma spectrometric analyses in the Surface Air Sampling Program was satisfactory. Blank analyses for ^{238}Pu and stable lead indicate that at the lowest levels encountered in the environment, the sampling and analytical systems may not be adequate. (auth)

14748 (HASL-268, pp II,1-58) HASL FALLOUT PROGRAM DATA. 1 Jan 1973.

In Fallout program. Quarterly summary report, September 1, 1972-December 1, 1972.

The Health and Safety Laboratory programs for fallout monitoring of atmospheric precipitation at world land sites and ocean weather stations, radioactivity measurements in the lower atmosphere over the western hemisphere using aircraft (Project Airstream) and balloon sampling, and ^{90}Sr determinations in US diets and human bones are outlined. Project Airstream activities during Jan. and July 1972 are discussed in detail. Tabulated data from Project Airstream on the gross gamma activity in and radiochemical analysis of air sampled during July 1972 are presented. (LCL)

Soil

14749 REPORT OF SURVEY ON RADIOACTIVITY INTENSITY IN NORTHERN NISHISONOGI PENINSULA AND NORTHWESTERN HIGASHISONOGI COUNTY, NAGASAKI PREFECTURE. Kiyoshima, N.; Harada, T. (Geological Survey of Japan, Kawasaki). Chishitsu Chosajo Geppo; 22: No. 8, 447-9(Aug 1971). (In Japanese).

Radioactivity measurements were carried out on a crystalline schist and secreting quartz vein, tertiary formation, lower basalt, Omodaka conglomerate layer, upper basalt, and an accumulating silica deposit in a diluvial formation. Duration of the measurements were from March 18 to 25, 1970. The surveyed region was in northern Nishisonogi peninsula and Kawatana town and Higashisonogi town in Higashisonogi county, Nagasaki prefecture. An outline of the geological features in the region is presented. Results of the measurements showed a minimum value of 0.005 mr/h and a maximum value of 0.016 mr/h, while the natural count was ±0.010 mr/h. No abnormal value was found at any spot. But limonite layers in the Omodaka conglomerate showed a tendency of slightly higher values. Quaternary basalt lava developed in the northern Nishisonogi peninsula is divided into upper and lower parts with tuff breccia interposed between them as in the Omodaka conglomerate. In the tuff breccia in the Kawatana and Higashisonogi towns, lake sediment is interposed and a limonite deposit is created. Distribution of radioactive minerals is not expected in the region in view of the basic geological features and geological structure. (Japan)

14750 RADIOACTIVE CONTAMINATION OF THE SOIL AND THE ASSOCIATED RADIOLOGICAL RISKS. Kirchmann, R. (CEN, Mol, Belgium). Ann. Gembloux; 77: 207-223(1971). (In French).

The sources of radioactive contamination—natural fission products from nuclear arms tests, and fission products and activation resulting from peaceful uses of nuclear energy—are reviewed, and the contribution of each to the contamination was evaluated. The associated radiological risks from soil contamination come from external irradiation of living beings, the passage into the food chain, and contamination of the phreatic nappe. The means of combatting this contamination is briefly indicated. (JSR)

Water

14751 (HASL-268, pp I,17-23) ^{90}Sr DEPOSITION IN THE ATLANTIC OCEAN: IV. Volchok, H. L. 1 Jan 1973.
In Fallout program. Quarterly summary report, September 1, 1972-December 1, 1972.

The ^{90}Sr deposition in the Atlantic Ocean, based on collections made at the four weather ship stations, is reported. It is concluded that no systematically higher fallout has occurred at these stations, compared to adjacent land masses, and that most differences can be accounted for by precipitation variations and longitudinal effects. The program has now been terminated. (auth)

14752 (NP-19637) RADIOACTIVITY AND WATER SUPPLIES. Lettinga, G. (Interuniversitair Reactor Instituut, Delft (Netherlands)). 1972. 197p. Dep. NTIS (U. S. Sales Only).
Thesis. Submitted to Technische Hogeschool, Delft, Netherlands.

A study of radioactive contamination of water supplies was undertaken to investigate the various factors involved in an emergency situation and to develop a simple, cheap, and effective method for drinking water decontamination and possibly radioactive waste treatment. Information is presented on causes of water supply contamination, decontamination methods, ion exchange theory, use of natural and modified peat as a sorbent, preparation and performance of modified peat, ^{131}I removal from water, and sorption of radioisotopes by clays and river silts. It is concluded that a crisis situation involving drinking water contamination will arise only during a nuclear war, not from peaceful uses of nuclear energy. For domestic purposes, a filter filled with a mixture of clay, sand, and peat can be used to decontaminate water with a low ^{131}I content. Modified peat treated by high-temperature heating in the presence of sulfuric acid is eminently suited for decontaminating drinking water supplies and treating radioactive waste solutions. Activated carbon can be used for ^{131}I removal. (LCL)

14753 (UCRL-51278) EVALUATING THE HAZARDS OF GROUNDWATER CONTAMINATION BY RADIOACTIVITY FROM AN UNDERGROUND NUCLEAR EXPLOSION. Levy, H. B. (California Univ., Livermore. Lawrence Livermore Lab.). 18 Sep 1972. Contract W-7405-eng-48. 25p. Dep. NTIS.

The contamination of a groundwater system by radioactivity from an underground nuclear explosion is considered on a step-by-step basis. A description is given of what happens in the immediate vicinity of an underground nuclear explosion and of how the radioactive products are initially distributed in the explosion region. Factors affecting the availability of the radioactivity to the groundwater in a flooded chimney are discussed. Besides the rate and direction of the groundwater flow, the major factors affecting the transport of radioactivity through the groundwater system are sorption on the surrounding rock and dispersion. These factors are discussed briefly in the text and given a fuller mathematical treatment in the Appendix. An example is given of an approximate calculation of the type often used to estimate whether or not radioactive contamination is a problem that warrants more detailed study. The summary discusses briefly what we know about the problem of radioactive contamination, some of the pitfalls involved in making estimates, and some additional studies that might be worthwhile. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 15111 and 15116.

14754 (CCHEN-RA-2/72) NUCLEAR TESTS 1971: EVOLUTION AND EFFECTS IN CHILE. Stuardo, E. (Comision Chilena de Energia Nuclear, Santiago). May 1972. 29p. (In Spanish). INIS.

The change in radioactive fallout resulting from the nuclear explosions carried out during the period June to August 1971 in the South Pacific is analyzed. The various doses to the critical organs resulting from the contamination of the atmosphere, natural milk, and vegetation were calculated. The maximum total dose to the thyroid from drinking mothers' milk was 6% of the annual dose limit and the danger of (radiation) dose to the bone marrow of the child and the adult through ingestion of natural milk represents less than 1% of the annual dose limit and of the annual dose to the red bone marrow resulting from background radiation, respectively. (tr-auth)

14755 (EUR-4901) INDIRECT RADIOACTIVE CONTAMINATION OF THE FOOD CHAIN DETERMINATION OF THE FACTORS OF TRANSFER SOIL/AGRICULTURAL PRODUCE AND SOIL/MILK IN THE EUROPEAN COMMUNITY. Lehr, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov 1972. 42p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 60,-.

An investigation was carried out under practical conditions to determine factors for the transfer of ^{90}Sr and ^{137}Cs from soil to food products, by making use of the cumulative deposit of these radionuclides resulting from fallout in the soil. Analyses were made of both crops and soils on which they had been cultivated. Special attention was paid to the variation of the soil factors concerned as a function of the properties of the soil, i.e., in the case of ^{90}Sr of the contents of the soil of exchangeable calcium and of calcium carbonate and in the case of ^{137}Cs of the contents of the soil of clay, organic matter and potassium. In acid and neutral soils the soil factor for ^{90}Sr was found to be negatively correlated with the exchangeable Ca. Contrary to this expectation, a tendency to increase in calcareous soils with the $CaCO_3$ content was shown, in particular above contents of 10 percent. In cases where several samples of fodder crops (grass and lucerne) were harvested on the same field in the course of the growing period seasonal variations occurred, to the effect that after an initial high contamination in spring followed a pronounced drop in summer, whereas in autumn the tendency was rather to increase again. It is assumed that the effect depends mainly on fluctuations of the degree of humidity of the soil. (auth)

Radiometric Techniques

14756 (ORO-3622-11) ABSOLUTE DATING OF OCEAN SEDIMENTS BY USE OF $^{230}Th/^{231}Pa$ RATIO AND GEOCHEMICAL STUDIES OF LIMITING BOUNDARY CONDITIONS WITH SPECIAL ATTENTION TO EXOTIC ENVIRONMENTS. Final Report. Rona, Elizabeth (Miami Univ., Fla. Rosenstiel School of Marine and Atmospheric Sciences). Feb 1972. Contract AT(40-1)-3622. 118p. Dep. NTIS.

I. A resume of research carried out under the heading Absolute Dating of Ocean Sediments by the use of $^{230}Th/^{231}Pa$ ratio—and Geochemical Studies of Limiting Boundary Conditions, with Special Attention of Exotic Environments is included. Special attention was given to dating of the Pleistocene epoch. The chronology and trend of climatic changes are best known for the recent past, up to 40,000 years by the method of ^{14}C dating. The climatic changes during the entire Pleistocene are documented by the $^{18}O/^{16}O$ method (Emiliani, 1955, 1966). The time scale for three Caribbean cores was provided by the $^{230}Th/^{231}Pa$ method. Briefly ^{230}Th, daughter of ^{234}U, and ^{231}Pa, daughter of ^{235}U, both produced in seawater, were almost immediately precipitated to the ocean floor by adsorption on mineral particles. The decay of the unsupported ^{230}Th and ^{231}Pa leads to a change of their ratio, which is a function of time alone. The ages are calculated by the equation: $t = 8.26 \ln [0.106 (^{230}Th/^{231}Pa)] \times 10^4$ years. Despite quite extensive previous research, the assignment of age values on the basis of activity measurements was hampered by lack of knowledge of the geochemistry of the uranium and thorium isotopes, and of protactinium, and of their chemical distribution at zero time and possible chemical and physical processes that could affect their distribution at a later time. Therefore, a different approach was tried by investigating the geochemistry of these elements under conditions which differ, in some cases extremely, from those in the open sea. Such conditions can be found in basins with stagnant seawater, in which oxygen is depleted and pH and Eh are lower than in the open sea. Landlocked seawater of Norwegian fjords, the Cariaco Trench off the continental shelf of Venezuela, and the Black Sea, the largest body of stagnant seawater, have been chosen for such investigation. II. Concentrations of the ferride metals Co, Ni, Fe, Mn, and U, have been determined in fjords of Norway and British Columbia, which have trapped seawater on the bottom. The concentrations of these elements have also been determined in cores taken from the Black Sea. The ratios of pairs of the ferride elements, Co/Ni, Ni/Fe, Co/Mn, were determined, and also their correlations. The most important factors responsible for the distribution and concentration of these elements are the stability of their sulfides, dilution and mixing effects with inorganic and organic matter. (auth)

14757 RADIOISOTOPE MEASUREMENTS OF FLOW RATES OF STREAMS FOR DETERMINING LEAKAGES TO A MINE. Kreft, A.; Zuber, A. (Inst. of Nuclear Physics, Krakow). Nukleonika; 17: No. 5-6, 305-12(1972). (In Polish).

A new version of the total count method was used for measurements of flow rates of two streams in order to find leakages from these streams to a mine. Flow rates were measured upstream and downstream exploited area and from these measurements inflows or outflows were found. All the measurements of flow rates were performed with an accuracy better than 1.5%. In one case it

was not possible to obtain a "good mixing" length and the accuracy was 3%. The new version of the total count method consists in defining the measuring volume by the application of a cylindrical lead screen around the detector. Part of the investigated stream flows through this cylinder immersed in the water. High efficiency of the screen is obtained by the use of a radioisotope of soft gamma radiation. (auth)

14758 RECENT ART FORGERIES. DETECTION BY ^{14}C MEASUREMENTS. Keisch, B.; Miller, H. H. (Carnegie-Mellon Univ., Pittsburgh). Nature (London); 240: No. 5382, 491-492 (22 Dec 1972).

An investigation was made of the detection of increased ^{14}C concentrations in artists' materials in connection with the identification of works of art produced since the advent of atmospheric nuclear weapons testing. The use of conventional ^{14}C dating to determine the age of paintings is precluded by the short time scale involved and by the need for large samples, but the very large increase of atmospheric ^{14}C caused by weapons testing in the 1950s and 1960s does offer a means of identifying substances produced from materials that were biologically active during and since that period. Linseed oil was thought to be a likely material in which to seek man-made ^{14}C, and hence specimens dating back to 1945 were obtained and the ^{14}C concentrations measured by liquid scintillation counting. A gas proportional counter operated in anticoincidence with a guard detector was also used. The results showed the expected increase, nearly doubling in the period 1945 to 1968. Paint samples were also examined, and the results demonstrated that oil paintings produced prior to the early 1950s could be distinguished from those produced in the late 1960s. The method was also applied to paper, wood, and canvas; it was found that paper of the 1960s could be distinguished from that produced prior to the 1950s. It is concluded that the detection of high ^{14}C concentrations in artists' materials offers a means of detecting recent art forgeries. (UK)

14759 ADVANCES IN HYDROSCIENCE. VOLUME 8. Chow, V. T. (ed.). New York; Academic Press, Inc. (1972). 366p. $24.50.

Advances in the study of water waves are examined in articles on seiches, on statistical models for ocean waves and wave forces, and on impulsive waves for model and prototype correlation. Sections are also included on fluvial sediment transport, isotope hydrology, and channel networks. A separate abstract was prepared for the section on isotope hydrology. (JRD)

For an abstract of an individual section see: 14760.

14760 ISOTOPE HYDROLOGY. Payne, B. R. (International Atomic Energy Agency, Vienna). Advan. Hydrosci.; 8: 95-138(1972).

The broad range of possible applications of isotope techniques that exist are reviewed to serve as a starting point for those wishing to go more deeply into the subject of isotope hydrology. Although further development of the different methods can be expected, the techniques based on environmental isotope variations seem likely to be emphasized. For example, their use in hydrometeorology has been rather limited and is perhaps an area where developments may be expected, particularly in view of the increased awareness of problems associated with the environment. (JRD)

Thermal Effluents

Refer also to abstracts 14745 and 16678.

INSTRUMENTATION

Radiation Detection Instruments

Refer also to abstracts 15314 and 15560.

General Detectors and Monitors

Refer also to abstracts 14516, 14529, 15392, 15476, 15477, 16587, and 16828.

14761 (AE–463) TWIN LARGE-AREA PROPORTIONAL FLOW COUNTER FOR THE ASSAY OF PLUTONIUM IN HUMAN LUNGS. Sharma, R. C.; Nilsson, I.; Lindgren, L. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Dec 1972. 49p. Dep. NTIS (U. S. Sales Only).

A twin large-area proportional flow counter used at Studsvik to directly assay low amounts of ^{239}Pu in human lungs by external detection of uranium L X-rays is described. The twin counter consists of two identical units. Each unit has a sensitive geometrical window area of 412 cm^2. The main detecting chamber is sandwiched internally between anticoincidence chambers for effective background reduction. The multiwire anodes form the high voltage planes in all chambers which operate in proportional mode with a mixture of argon and methane as the counting gas flowing at atmospheric pressure. The salient features of counter design are discussed, and the performance characteristics given. The background inside the Studsvik iron room was initially found to be dependent on the angular orientations of the counter units. With both units horizontal it was 3.20 cpm in the energy band 11 to 25 keV, but this was reduced to 1.70 cpm by anticoincidence supplementation which also considerably reduced the angular dependence of the background rate. A discussion of these features is included. The counting efficiencies for different detector configurations were studied with a phantom containing homogeneously distributed Pu in the lungs. The calibration results indicate the achievable limit of detection (two times the standard deviation in background rate) to be 7 nCi of ^{239}Pu for a counting period of 100 min. The corresponding figure for a subject with 6.8 nCi ^{137}Cs and 146 g K is 10 nCi. A further reduction in background is anticipated on the basis of the preliminary results obtained using a pulse rise-time discrimination technique. (auth)

14762 (BARC/I–153) PRESET TIMER WITH BCD OUTPUT AND ELAPSED TIME DISPLAY. Samuel, J. K.; Ponkshe, M. R.; Jain, A. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 5p. INIS.

The design of a pre-set timer, to be used for automatic printing out of scaler readings to facilitate the use of counting systems for unattended, over-night operation is described. The timer counts 1-second clock pulses from an accurate source until the preset time is reached and sends the appropriate signal to stop the scaler which is counting the nuclear particle detector output. The timer consists of five units: (i) control circuit, (ii) clock pulse counter, (iii) binary coded decimal outputs (BCD), (iv) thumbwheel switches and, (v) elapsed time display. The timer is operated by an external source of positive 1-second timing pulses of 5 to 10 volts amplitude. The limit has been built in a double width modular form and can be plugged in to a standard ECIL bin. Logic levels of the timer are logic "1": +10V ± 1V and logic "0": 0V ± 1V and the power supply requirements are +12V: 300 ma; –12V: 20 ma and 230 V a/c: 20 ma. (INIS)

14763 (BNL–17237) 32-CRYSTAL POSITRON TRANSVERSE SECTION DETECTOR. Robertson, J. S.; Marr, R. B.; Rosenblum, M.; Radeka, V.; Yamamoto, Y. L. (Brookhaven National Lab., Upton, N. Y.). 1972. 24p. (CONF-720959–1). Dep. NTIS.

From Symposium on radionuclide tomography; New York, NY (15 Sep 1972).

The operation and performance of a 32-detector positron section scanner for medical uses such as brain scanning are described. The NaI(Tl) detector system, data processing, display, and applications are discussed. (WHK)

14764 (CALT–767-P-11-X-4) STUDY OF DEEP LEVELS IN DETECTOR-GRADE GERMANIUM BY CHARGE TRANSPORT TECHNIQUES. Marrello, Vince; Ottaviani, Gianpiero; Mayer, J. W.; Nicolet, M.-A. (California Inst. of Tech., Pasadena. Dept. of Electrical Engineering). 22 Dec 1972. Contract AT-(04-3)-767. 12p. Dep. NTIS.

A study to determine if solid-state epitaxial growth can be achieved by evaporating Ge on the Al layer on crystal Ge and then heating is described. If successful, this approach would simplify fabrication of detectors. The kinetics of crystallization processes in evaporated Si/Ag and Ge/Al films were studied by He^+ ion backscattering techniques, transmission electron diffraction, scanning electron microscopy, and electron microprobe analysis. It was shown that crystallization can occur by dissolution of the semiconductor into the metal film followed by growth of crystallites. (WHK)

14765 (CONF-700929–(Vol.2), pp 1119-32) DESIGN AND ANALYSIS OF A DIGITAL NEUTRON DETECTION SYSTEM. Pyros, I. E. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A neutron detection system using methane–argon ionization chambers is analyzed as part of a security system for the BNL 200 MeV linear accelerator. Optimum signal to noise criteria are discussed for this particular system together with an analysis of coherent detection for maximum signal-to-noise ratios. An FET-Transistor differential amplifier is analyzed for partial system fabrication. A coherent system utilizing an existing digital display is proposed. (auth)

14766 (EGG—1183–2288) DESIGN AND CHARACTERIZATION OF AN ABSOLUTE GAMMA-RAY INTENSITY DETECTOR. Stevens, J. (EG&G, Inc., Goleta, Calif.). Apr 1972. Contract AT(29-1)-1183. 39p. Dep. NTIS.

For California Univ., Livermore. Lawrence Livermore Lab.

Well established photon-electron calculational techniques have been applied to the design of a special vacuum Compton diode detector whose window-emitter materials and configuration give it a gamma-ray sensitivity that is relatively independent of photon energy, enabling it to measure total gamma-ray intensity without reference to the gamma-ray spectrum. Another unique feature of the detector is its extremely low absolute sensitivity, which allows it to operate at very high radiation flux levels. The detector, whose physical size and window-emitter geometry are almost identical to those of the Lawrence Livermore Laboratory's standard L-125 Compton detector, has several applications in intense radiation burst diagnostics, where its special advantage would, of course, be its fast time resolution and ability to measure gamma-ray intensity without the need for detailed knowledge of the gamma-ray spectrum. The calculated and normalized monoenergetic gamma-ray sensitivity of the absolute gamma-ray intensity detector is presented and compared to the calculated sensitivity of a standard L-125 detector. (auth)

14767 (IAE–2130) APPROXIMATE METHODS TO DETERMINE A NEUTRON FLUX IN EXCESS OF 0.1 MeV IN EXPERIMENTAL REACTOR CHANNELS. Levin, B. A. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 27p. (In Russian). INIS.

A method has been proposed for the determination of neutrons with energies in excess of 0.1 MeV as based on the measurement of fluxes greater than 1 keV and 3 MeV, respectively ($\varphi_{>0.001}$ and $\varphi_{>3}$). The determination of neutron fluxes in excess of 0.1 MeV ($\varphi_{>0.1}$) was performed with the aid of the dependence of $\varphi_{>0.1}/\varphi_{>3}(\eta)$ on $\varphi_{>3}/\varphi_{>0.001}(R)$, obtained from the values of η and R for known reactor spectra. Values of η were obtained at various points in the vertical channel of Reactors OR, VVR-2 and IIN. The method of measuring $\varphi_{>0.1}$ in a recess of the Reactor OR according to the number of fissions of ^{239}Pu embedded within a thick filter of B_4C is described. (tr-auth)

14768 (INR-P–1378/2/PS) CdTe NUCLEAR RADIATION DETECTORS. Khvashchevska, Ya.; Dombrovski, A.; Lekhovich, T.; Gir'yat, V. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 13p. (In Russian). INIS.

Nuclear radiation detectors based on homemade cadmium telluride were developed and made. Surface barrier technology was applied for preparing the junction. The current–voltage characteristics and the response to monoenergetic alpha particles and gamma radiation were measured. (auth)

14769 (N–72-24863) RADIATION MEASUREMENT EXPERIMENT FOR APPLICATIONS TECHNOLOGY SATELLITE-E. Final Report. Mozer, Forrest (California Univ., Berkeley. Space Sciences Lab.). 9 Mar 1972. Contract NAS5-10362. 35p. (NASA-CR–122415). NTIS.

Scintillation detectors are described for the ATS 5 satellite. Operation, electronics, and experiment sequencing and telemetry are considered. Schematics and calibration tables are included. (STAR)

14770 NEW METHOD FOR X-RAY ENERGY SELECTION USING A SCINTILLATION COUNTER AND BALANCED FILTERS. Rhodes, J. R.; Morgan, I. L.; Furuta, T. (Columbia Scientific Research Inst., Austin, TX). pp 305-16 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Experiments are reported on a measurement technique for use with scintillation detectors that enables the two balanced filter readings to be made by using a single probe and subtracted simultaneously without moving the filters, the sample, or the probe. The "double phosphor probe" consists essentially of two phosphors having different responses to incident x rays. The two phosphors are mounted on a single photomultiplier whose output pulses corresponding to scintillations in each phosphor are separated electronically by pulse shape discrimination. The characteristics of the probe and the choice of phosphors, characteristic x rays, sources, and filters are discussed. An investigation of the feasibility for lead determination in artificial ores and for lead and barium determination in paint films is recounted. (6 figures, 2 tables) (RWR)

14771 LARGE AREA SILICON X-RAY DETECTORS. Frankel, R. S. (Kevex Corp., Burlingame, CA); Aitken, D. W. pp 335-55 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The present state of the art permits construction of superior detectors with areas up to 200 mm^2 and of quite good devices with areas all the way up to 1250 mm^2. It is shown that, for many applications, the loss in spectral resolution with large-area detectors is no longer a serious penalty, but rather only a minor offsetting factor to a very positive gain in experimental sensitivity and suitability. The dependence of system resolution on energy and detector area is given, and a number of practical applications in system design are included. Maximum sensitivity, as opposed to maximum resolution, can be obtained through the use of large detectors. It is demonstrated that neglect of count-rate effects does not change the above conclusions. (13 figures, 1 table) (RWR)

14772 CURVED POSITION-SENSITIVE DETECTOR FOR X-RAYS. Semmler, R. A. (Illinois Inst. of Tech., Chicago). pp 399-408 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The design and testing of a curved, position-sensitive x-ray proportional counter are described. Charge division is used to measure position with a resolution of about 0.4 mm. The resolution is comparable to results obtained with x-ray film, but the former technique is about 20 times faster. The present detector covers an angular range of 15°, but much greater ranges appear practicable. (8 figures, 2 tables) (RWR)

14773 ENERGY-FLUX METER FOR 1 TO 10 A X-RAYS. McCrary, J. H. (EG and G, Inc., Las Vegas, NV); Lyons, P. B.; Baran, J. A. pp 409-15 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

An attempt to circumvent difficulties inherent in counters and free-air chambers led to the development of the xenon ionization chamber. Basically, this device is a detector whose entrance window is transparent and whose fill gas is opaque to photons over a given wavelength region. Photons incident on the chamber dissipate most of their energy in ionizing the fill gas. The design and operation of the xenon ionization chamber are described, and the theoretical efficiency is calculated. The xenon-filled, total-absorption ionization chamber provides a simple, direct, and accurate method for measuring the energy flux contained in a low-energy x-ray beam. It is sensitive to low intensities, but is not limited by high-intensity beams. Beam intensities can be measured with a xenon ionization chamber in the 1 to 10 A region with an accuracy of ±2 to 4%. (4 figures) (RWR)

14774 PROPERTIES OF IONIZING-RADIATION COUNTERS MADE OF SILICON CARBIDE DOPED BY DIFFUSION OF BERYLLIUM. Tikhomirova, V. A.; Fedoseeva, O. P.; Kholuyanov, G. F. Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 5, 831-832(Nov 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 5, 957-959(May 1972).

Diffusion of Be into SiC at 1600 to 1700°C for 30 to 50 min produced p−n junctions with sensitive regions 5 to 7 μ thick and a sensitive area of 3 mm^2. Their operation was tested using ^{238}Pu source. They have lower reverse currents, higher avalanche breakdown voltages, and lower noise than SiC doped with Al or B. The amplitude of the collected charge pulses increased with temperature. When the Be-doped SiC detectors were used as spectrometers, their resolution was 8%. (DLC)

14775 FORMATION OF A SIGNAL IN SEMICONDUCTOR DETECTORS. Eremin, V. K.; Strokan, N. B.; Tisnek, N. I. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 5, 833-835(Nov 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 5, 959-962(May 1972).

A study was made of the shape of current pulses produced by α particles in a Ge detector, using changes in bias and saturation of the carrier drift velocity. The absence of a flat top in the current pulse at saturation indicates that the signal $\Delta Q = Q(\Delta V/V)$ and not $Q(\Delta X/d)$. Further proofs that $\Delta Q = Q(\Delta V/V)$ are given. (DLC)

14776 HIGH-RESOLUTION COUNTERS MADE OF GERMANIUM WITH RADIATION DEFECTS. Dudnik, E. P.; Eremin, V. K.; Levinzon, D. I.; (and others) (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 4, 679-680(Oct 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 4, 779-781(Apr 1972).

Compensation of n-type Ge by γ rays results in reduced carrier lifetime and resolution. The number of radiation defects needed for compensation can be reduced by reducing the background of accidental impurities and defects N_b. Properties were studied of counters prepared from Ge with uncompensated donors $\sim 10^{12}$ cm^{-3} but with N_b reduced by more than one order of magnitude. The mean charge losses were found to be ≤0.05%, and the carrier lifetime (capture time) was determined as a function of field intensity. (DLC)

14777 RADIOMETRIC AND DOSIMETRIC APPARATUS OF THE NEAR FUTURE. Matveev, V. V. Yadern. Priborostr.; No. 12, 3-14(1970). (In Russian).

The contemporary status and tendencies in the development of radiometric and dosimetric apparatus are examined. The basic conditions for building individual systems for the measurement of physical magnitudes characterizing ionizing radiation are reported. New types of radiometric and dosimetric devices, developed recently and already in commercial usage, were described. (5 figures) (tr-auth)

14778 SEMICONDUCTOR DETECTORS OF FOREIGN MANUFACTURE. Erykhailov, Yu. V.; Sel'dyakov, Yu. P.; Timofeev, A. A. Yadern. Priborostr.; No. 12, 110-19(1970). (In Russian).

The technical and advertising materials of foreign (outside USSR) firms manufacturing semiconductor radiation detectors are summarized. Data on the measurement parameters and prices of germanium and silicon detectors are reported. (2 figures, 5 tables) (tr-auth)

14779 EXPERIMENTAL INVESTIGATION OF THE PROPORTIONAL X-RAY FLOW COUNTERS SRPP-30 AND SRPP-31. Babichenko, S. I.; Mal'kov, V. V.; Sklyankin, V. A. Yadern. Priborostr.; No. 12, 161-9(1970). (In Russian).

The purpose and basic characteristics of the proportional x-ray flow counters of the SRPP-30 and SRPP-31 types were described. One of the possible methods of stabilization of the amplification factor of the counter was examined. The results of the experimental study were reported. (8 figures) (tr-auth)

14780 SENSITIVITY THRESHOLD AND PRECISION OF AEROSOL BETA RADIOMETERS. Bolotin, V. F.; Zalmanzon, Yu. E. Yadern. Priborostr.; No. 12, 192-203(1970). (In Russian).

Questions on the evaluation of the sensitivity threshold and precision of several β radiometers with continuously moving filter tape and separate arrangement of the sampling window and detector were examined. The minimum measurable concentration of the β-active aerosols for radiometers of this type was determined. (4 figures, 3 tables) (tr-auth)

14781 COMPARATIVE CHARACTERISTICS OF THE REFLECTING AND EMISSION PROPERTIES OF METALLIC COVERINGS. Kovalenko, V. G.; Lein, E. L.; Polenov, B. V.; Sizov, V. V.; Shifrin, A. V. Yadern. Priborostr.; No. 12, 237-43(1970). (In Russian).

The results of the investigation of the reflecting and emission properties of the most common coverings made in different forms were reported. The optimum types of coverings for analyzing and detecting installations were selected. Calculated and experimental data on the attenuation factor of ultraviolet radiation with rotating analyzing systems were reported. The basic methods of increasing the sensitivity and selectivity of charged-particle spectrometers were examined. (2 figures, 3 tables) (tr-auth)

14782 DETERMINATION OF THE PHOTOFRACTION OF NaI(Tl) CRYSTALS BY THE MONTE CARLO METHOD. Belov, O. Kh.; Vartanov, N. A.; Samoilov, P. S. Yadern. Priborostr.; No. 12, 244-9(1970). (In Russian).

The photofraction (the fraction of γ quanta completely absorbed in the crystal) was determined by the Monte Carlo method for cylindrical NaI(Tl) crystals with dimensions of 40 × 40, 63 × 63, 150 (dia) × 100 mm at γ energies of 0.320 (^{51}Cr), 0.662 (^{137}As), 1.333 (^{60}Co), and 2.754 MeV (^{24}Na). The precision of the determination of the size of the photofraction was ±1.5, ±4, ±6, and ±10%, respectively. The distance of the source was 10 cm. For crystals with the dimension 63 × 63 mm the photofraction was determined for three source–crystal spacings of 0.5, 10, and 50 cm. A very slight dependence of the size of the photofraction on the source–crystal spacing was detected. This dependence is in satisfactory agreement with results obtained in other studies. (2 figures, 2 tables) (tr-auth)

14783 PROPORTIONAL COUNTER WITH A MOVABLE INSULATOR FOR ABSOLUTE MEASUREMENTS OF THE ACTIVITY OF NUCLIDES IN GASES. Albul, V. I.; Baranov, V. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 346-348(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 43-44(1972).

The results of investigating two counters with a movable insulator for radiometric measurements of nuclides in gases are described. The structural features of the counters are presented. (1 figure, 1 table) (auth)

14784 DEPENDENCE OF THE ENERGY RESOLUTION OF THE PROPORTIONAL COUNTER ON THE GAS MULTIPLICATION FACTOR. Goganov, D. A.; Zhukovskii, A. N.; Komyak, N. I.; Ponomarev, V. S.; Tsvetova, N. B. (Special Design Bureau of X-Ray Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 349-350(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 45-46(1972).

An experimentally obtained dependence of the energy resolution of proportional x-ray counters on the magnitude of the gas multiplication factor is presented. (2 figures) (auth)

14785 EFFICIENCY OF NEUTRON COUNTERS HAVING A GAS RADIATOR. Tolchenov, Yu. M.; Chaikovskii, V. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 351-352 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 47-48(1972).

In many important practical cases the efficiency of a neutron counter may be estimated rapidly and with a fair accuracy by using graphs which relate the efficiency of neutron recording to the radius of the cylindrical counter, the type of gas radiator, and the pressure of the radiator. Graphs are plotted for determining the efficiency of a counter in an isotropic flux and in a flux perpendicular to the counter axis. (1 figure, 1 table) (auth)

14786 EFFECT OF NOISE AND TEMPERATURE ON THE COUNTING CHARACTERISTICS OF SCINTILLATION COUNTERS. Pronkin, N. S.; Khakhalin, V. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 357-360(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 52-54(1972).

The effect of the noise of NaI(Tl) and CsI(Na) scintillation detectors caused by the fluorescence of the crystal on the counting characteristics of the scintillation counter is considered. Experimental data on the effects of temperature (±50°C) and the signal-to-noise ratio on the number of noise peaks which determine the formation of the high-voltage region of the counting characteristic are presented. Methods for improving the parameters of the counting unit are advanced. (4 figures) (auth)

14787 ELECTRON EMISSION AS A RESULT OF THE PASSAGE OF HIGH-ENERGY ELECTRONS THROUGH THIN FOILS. Vit'ko, V. I.; Kovalenko, G. D.; Stratienko, V. A. (Physical-Technical Inst., Kharkov). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 478-479(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 148-149(1972).

A secondary-emission monitor is described which allows emission electrons to be segregated into two groups: tertiary electrons (0 to 120 eV) and secondary electrons (120 eV to E_0). The contribution of these groups to the overall electron yield was investigated for the primary-electron energy interval from 3 MeV to 1 GeV. The energy dependence of the yield of secondary electrons was revealed experimentally. The advantages of a monitor operating in a mode in which secondary electrons are recorded are discussed. (3 figures) (auth)

14788 USE OF THE ANOMALOUS PHOTOVOLTAGE OF AN Si OR Ge FILM TO RECORD X-RADIATION. Arifov, U. A.; Abdullaev, N. (Inst. of Electronics, Tashkent). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 556-557(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 210-212(1972).

The effect of x radiation on the magnitude of the high-voltage photovoltage of Si and Ge films was investigated. The possibility of using these films to record x rays of low intensity both in air and in a vacuum was demonstrated. (3 figures) (auth)

14789 MULTIWIRE PROPORTIONAL CHAMBERS FOR BIOMEDICAL APPLICATION. Kaplan, S. N.; Kaufman, L.; Perez-Mendez, V.; Valentine, K. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 106: No. 2, 397-406(1973).

Multiwire proportional chambers with delay-line readouts, currently used for particle trajectory measurements in high-energy physics, are being adapted for a variety of biomedical applications including X-radiography, neutron radiography, and radioisotope imaging. Chamber design features are described, and calculated and measured efficiency and resolution data are given. Sample radiographic images taken with prototype chambers are shown. (auth)

14790 IMPROVED DELAY LINES FOR PROPORTIONAL WIRE CHAMBER READOUT. Grove, R.; Perez-Mendez, V.; Sperinde, J. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 106: No. 2, 407-408(1973).

Various modifications to the electromagnetic delay lines used for wire chamber readout are described. These consist of changing the cross-section of the lines, decreasing the eddy current losses, the dielectric losses, and increasing the characteristic impedance. The effect of these modifications is to increase the coupling efficiency to the chamber wires and to make the delay-to-risetime ratio equal to 30 for a 50-cm long delay line, with a total delay of 2.65 μs. (auth)

14791 TIME DELAY EFFECTS IN A NEUTRON DETECTOR SURROUNDED BY POLYTHENE AND APPLIED TO A STATISTICAL NEUTRON COUNTING EXPERIMENT. Moberg, L. (Aktiebolaget Atomenergi, Studsvik, Sweden). Nucl. Instrum. Methods; 106: No. 2, 357-363(1973).

An ^{3}He-gas scintillation neutron detector was used for a statistical neutron counting experiment by the "variance-to-mean" method in the FRO reactor. In order to increase the efficiency for high energy neutrons the detector was surrounded by a layer of polythene. The time delay of the neutrons in the polythene before detection was experimentally studied by the pulsed neutron source method. On the basis of the experimental result a model for the internal time dependence between consecutive detections is constructed and the expression used in the evaluation of the "variance-to-mean" experiment is derived. (auth)

14792 ACCURATE EFFICIENCY CALIBRATION AND PROPERTIES OF SEMICONDUCTOR DETECTORS FOR LOW-ENERGY PHOTONS. Hansen, J. S.; McGeorge, J. C.; Nix, D.; (and others) (Georgia Inst. of Tech., Atlanta). Nucl. Instrum. Methods; 106: No. 2, 365-379(1973).

Methods are given for investigating the properties and determining precision detection efficiencies of semiconductor Si(Li), Ge(Li), and intrinsic Ge photon detectors in the energy range 3 to 100 keV. The accuracy with which the efficiency curves can be established depends in part on the individual detector; an accuracy of ≈±3% between 6 and 60 keV could be achieved for the intrinsic Ge detector due to the relative simplicity of its sensitive volume and its low tail/peak ratio. In general, accuracies of 3 to 5% between 5 and 100 keV are achieved. Four typical detectors have been investigated extensively and a theoretical physical model developed for calculation of detection efficiencies to assist in the interpolation between the experimental points. For each detector, the procedure involves three separate steps: (1) accurate experimental measurement of the absolute detection efficiency at a standard geometry with calibrated photon-emitting radioactive standards; (2) accurate determination of the parameters required to predict from the theoretical physical model the absolute detection efficiency, such as source-to-detector distance, thickness of the gold and the Si or Ge deadlayers, the sensitive depletion depth, the sensitive detection area, collimation geometry, and charge collection efficiency; and (3) a fit of the experimental points with the theoretical model to minimize errors in interpolating between the points and to reveal anomalies. Results of narrow-beam photon scanning across the face of the detectors are presented and tail/

peak ratios are given and discussed. A useful compilation is included of the photon energies and latest values of the emission rates per decay for the following radioactive standards: ^{241}Am, ^{57}Co, ^{60}Co, ^{137}Cs, ^{203}Hg, ^{54}Mn, ^{22}Na, ^{88}Y and ^{182}Ta. In addition to these sources, others were calibrated by a new multiwire proportional counter technique or by application of the conversion electron-X-ray coincidence (CEX) technique. Rather substantial changes (≈20%) in efficiency and in tail/peak ratios were observed in some detectors with ageing, or, in the case of a Si(Li) detector, after a one-hour warmup cycle. It is concluded that each detector requires an individual determination of efficiency, as no two detectors are alike in all of their properties even though their nominal specifications may be identical, and that such efficiency determinations must be repeated, since changes occur with time, temperature, and other treatments. The mean life of cooled semiconductor X-ray detectors against failure appears to be approximately 18 months. (auth)

14793 RESOLUTION OF A POSITION SENSITIVE $^{10}BF_3$ PROPORTIONAL COUNTER. Westphal, G. P. (Atominstitut der Oesterreichischen Hochschulen, Vienna). Nucl. Instrum. Methods; 106: No. 2, 279-283(1973).

A position sensitive neutron detector system is described, which has a locus resolution of 3.75 mm fwhm at 1 atm filling pressure. (auth)

14794 APPARATUS FOR RECORDING SCINTILLATION PULSE CONTOURS FROM LIQUID SOLUTIONS EXCITED BY IONIZING PARTICLES. Berlman, I. B.; Steingraber, O. J. (Argonne National Lab., IL). Nucl. Instrum. Methods; 106: No. 2, 285-287(1973).

Apparatus for accurately recording scintillation pulse contours is described and sample pulse shapes for excitation by α and β particles are presented. A favorable characteristic of this equipment is that it can reproduce the scintillation pulse with high fidelity in about 15 min. This equipment is well suited for studies of solutions to be used in pulse-shape discrimination and for studies of dynamic quenching. (auth)

14795 ELECTRON SCATTERING EFFECTS IN DIRECTIONAL CORRELATIONS. Stefansson, V.; Holmberg, L.; Pettersson, B. G. (Univ. of Stockholm). Nucl. Instrum. Methods; 106: No. 2, 289-294(1973).

Electron scattering effects in directional correlations are studied by use of a magnetic electron spectrometer. Foils of various metals are placed in front of the radioactive source. The results are compared with a theory by Frankel, which is generally used to correct for scattering effects in directional correlations. The theory is found to be approximately valid. However, it is shown that the scattering effect depends critically on the properties of the electron spectrometer used. Thus, the concept of scattering, as generally used, is ambiguous. Due to the difficulty of estimating the source thickness, it is suggested that the scattering correction is related to the readily determined energy loss of the electrons. Scattering versus energy-loss curves, valid for the lens type spectrometer used, are presented. Such curves should make feasible the use of thicker sources than hitherto have been found acceptable. (auth)

14796 EFFECT OF ENERGETIC ELECTRON IRRADIATION UPON CHARGED-PARTICLE TRACK REGISTRATION IN POLYCARBONATE FILMS. Goland, A. N.; der Mateosian, E. (Brookhaven National Lab., Upton, NY). Nucl. Instrum. Methods; 106: No. 2, 295-299(1973).

Samples of Lexan polycarbonate were exposed to 2-MeV electrons for short periods of time. The samples were also exposed to a ^{252}Cf source of fission fragments, and were subsequently etched to develop the fission-fragment tracks. The electron irradiation caused a marked change in the bulk etching rate of the plastic. The experiments leading to this conclusion and the consequences of the effect are discussed. (auth)

14797 DETERMINATION OF TRACK PARAMETERS BY DIFFRACTION METHOD USING LASER LIGHT. Varnagy, M.; Szabo, J.; Juhasz, S.; Csikai, J. (Kossuth Univ., Debrecen, Hungary). Nucl. Instrum. Methods; 106: No. 2, 301-305(1973).

Measurements were performed for determining the diameter of tracks by the Fraunhofer-diffraction method. A ≈1 mW He–Ne gas laser as a light source as well as cellulose acetate track detectors irradiated with alpha particles at different energies were used. The diameter of tracks determined by the diffraction method as well as those measured by microscope are in good agreement with each other. (auth)

14798 EXACT LEAST SQUARES FITTING OF GAMMA RAY ANGULAR DISTRIBUTIONS WITH SEVERAL RESTRICTED LINEAR PARAMETERS. Bell, R. A. (Australian National Univ., Canberra). Nucl. Instrum. Methods; 106: No. 2, 307-310(1973).

A method is described for least squares fitting of gamma ray angular distributions to theoretical formulae in which a number of linear parameters vary freely between defined limits. (These linear parameters correspond to the relative populations of the initial nucleus' magnetic substates.) The method is readily programmed for a small computer. (auth)

14799 MEASUREMENTS OF GAMMA-RAY ATTENUATION COEFFICIENTS OF ORGANIC SCINTILLATORS. Goswami, B.; Chaudhuri, N. (Univ. of North Bengal, India). Nucl. Instrum. Methods; 106: No. 2, 317-318(1973).

Total gamma-ray mass attenuation coefficients have been measured for fifteen organic scintillators at seven energies of gamma-rays from radioactive sources. Experimental errors in the measurements are less than 1%. (auth)

14800 DETECTOR FOR LOW-ENERGY CHARGED PARTICLES. Veselova, G. A.; Kovalenko, V. G.; Polenov, B. V.; Khazanov, B. I. Yadern. Priborostr.; No. 12, 75-84(1970). (In Russian).

A structural circuit and characteristics of the detection assembly for low-energy charged particles, including an electrostatic analyzer and a channel electron multiplier, were reported. The basic characteristics of the curved and twisted tubular electron multiplier during recording of electrons with energy between 0.1 and 15 keV were reported. (tr-auth)

14801 MOMENTUM MEASUREMENTS IN NUCLEAR EMULSIONS EXPOSED IN A MEGAGAUSS FIELD. Heckman, H. H. (Univ. of California, Berkeley); Herlach, F. Nucl. Instrum. Methods; 106: No. 2, 269-273(1973).

Although the generation of a megagauss magnetic field inevitably destroys the field-producing coil, the explosion is radial, permitting nuclear emulsions to be exposed in the field without physical damage. Measurements of particle momenta by track curvature in nuclear emulsions exposed to a pulse of electrons from the Stanford Linear Accelerator while in a 0.92 MG field are reported. The errors in the curvature measurements are accounted for by the effects of multiple Coulomb scattering alone. The rms error is given by the expression $\sigma(\rho)/\rho = 2.5\, l^{-\frac{1}{2}}$, where l (μm) is track length upon which ρ, the radius of curvature, is based. (auth)

14802 MEASUREMENTS OF THE AVERAGE ENERGY PER ELECTRON–HOLE PAIR GENERATION IN SILICON BETWEEN 5 AND 320°K. Canali, C. (Univ., Modena, Italy); Martini, M.; Ottaviani, G.; Alberigi Quaranta, A. IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 4, 9-19(Aug 1972).

The average energy expended to create an electron-hole pair in silicon $\epsilon_{Si}(T)$ has been measured in the 5 to 320°K temperature range with thin totally depleted surface barrier and diffused junction radiation detectors. The data have been normalized to a value of ϵ_{Si} (300°K) = 3.62 eV. A dependence of ϵ_{Si} on T much weaker than previously published by other authors has been observed. In the examined temperature range (5 to 320°K) the data are well fitted by $\epsilon_{Si}(T) = 2.15\, E_g(T) + 1.21$ eV where $E_g(T)$ (in eV) is the value of the forbidden bandgap. (auth)

14803 PRACTICAL METHOD FOR NEUTRON DETECTION BY FISSION TRACK REGISTRATION. 1. Koshijima, Tokusaburo (National Inst. of Radiological Sciences, Chiba, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 8, 928-932(Nov 1971). (In Japanese).

An easy method for neutron detection based on fission tracks in solids is reported. A small amount of solution of fissionable material was evaporated on a solid. The fissionable layer had a thickness of 15 to 30 mg/cm^2. Uranylacetate served as the fissionable material. For the track registrating solid, the dosimeter glass (FD-P8-3, Toshiba) and a cellulose triacetate sheet were used. To investigate the effect of the thickness of the fissionable layer on the track density, detectors that had various thickness of the layer were studied. There was a linear relationship between track density and neutron flux. For thin fissionable layers of less than 5 mg/cm^2, the track density depends on the thickness of layer. The combination of a dosimeter glass with uranylacetate had a sensitivity of 1.9×10^{-6} tracks/neutron for the Ra–Be source. (auth)

14804 DEVELOPMENT OF PLASTIC DETECTORS AND THEIR APPLICATION IN THE BIOSTACK (APOLLO 16). Enge, W. Atomkernenergie; 20: No. 3, 231-234(Dec 1972). (In German).

Specific etching and analysis procedures have been developed to use industrially manufactured plastic sheets such as cellulose nitrate and Lexanpolycarbonate as particle detectors. In a biophysical experiment, called Biostack, on board Apollo 16, single biological objects hit by heavy cosmic ray nuclei could be identified

using plastic detectors. The charge and isotope spectrum of the cosmic ray nuclei with Z = 4 to 8 of the energy 100 to 200 MeV/Nuc has been measured using cellulose nitrate sheets. The charge spectrum of nuclei Z = 12 to 28 was measured with Lexan sheets. (auth)

14805 TRACK-DIAMETER KINETICS IN SOLID STATE NUCLEAR TRACK DETECTORS. Somogyi, G.; Szalay, A. S. (Eoetvoes Lorand Univ., Budapest). ATOMKI (At. Kut. Intez.) Kozlem.; 14: No. 3, 113-160(1972). (In Hungarian).

The diameters (generally minor and major axes) of etch-pits in dielectric nuclear track detectors are gradually increasing while being etched. The general theoretical description of this phenomenon (track-diameter kinetics) is given, considering particles entering the detector at arbitrary angles. The model has been extended to both isotropic and anisotropic detector solids. Formulas describing the variation of track-diameters during the etching process in the case of constant and varying etching rate along the particle trajectory are discussed. The characteristics of the model are illustrated with special cases. On the basis of these theoretical results some new methods for the experimental determination of particle parameters (etching rate along trajectory, entrance angle, and range) are suggested. These methods, applied to studying etch-pits of spontaneous fission fragments registered in detectors like glass, can help in hunting for superheavy transuranic elements. (auth)

14806 USE OF ^{231}Pa AND ^{236}U IN THE MEASUREMENT OF FAST NEUTRON SPECTRA. Koshaeva, K. K.; Kraitor, S. N. At. Energ. (USSR); 34: No. 1, 49-52(Jan 1973). (In Russian).

The accuracy of measurement of fast-neutron spectra may be improved by the use of threshold detectors of fissioning isotopes of ^{231}Pa and ^{236}U. Calculations were made for neutron spectra in different critical assemblies, reactors and shielding, plotting the effective cross section (barns) against the threshold energy (MeV) for the two isotopes. The resulting intersection of the curves furnished the optimum values: 0.72 MeV, 1.28 for ^{231}Pa; and 0.95 MeV, 0.79 for ^{236}U. Neutron spectra chosen from a variety of sources (Pu–Be, fission, various reactors) were used to test the accuracy of the proposed Pa and U threshold detectors. (3 figures, 1 table) (KSW)

14807 ION CHAMBER ASSEMBLY (13 Nov 1972) (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-2288). 1 drawing.

The ion chamber was designed for checking shipments of xenon-133. It has an effective volume of 880 cu. cm., and was filled with xenon at 76 cm pressure. (WHK)

14808 EXPERIMENTAL VERIFICATION OF THE FLATNESS OF RESPONSE OF A MULTI-BF_3-COUNTER NEUTRON DETECTION SYSTEM. Crawford, D. M.; Thomas, B. W.; Boettcher, K.; Koch, R.; Thies, H. H. (Univ. of Western Australia, Nedlands). Nucl. Instrum. Methods; 106: No. 2, 311-315(1973).

The constancy of the detection efficiency η of a multi-BF_3-counter neutron detection system built after a proposal by Thies was tested experimentally. In experiment (1) the neutron yield from ^{2}D(γ,n) for bremsstrahlung peak energies 6 MeV < E_0 < 15.25 MeV was compared with yield values calculated with a theoretical ^{2}D(γ,n)-cross-section. In experiment (2)—for the range 18.5 MeV < E_0 < 27.7 MeV—the neutron yield from a natural carbon target was measured with the multi-BF_3-counter neutron detection system and concurrently by counting the 20.3 min positron activity induced in ^{11}C. Finally the neutron yield from a carbon target enriched in ^{13}C to 90% was measured, and the ^{12}C(γ,n)-yield obtained from the natural carbon one by subtraction. By intercomparison of yields in experiments (1) and (2) the constancy of η was verified independently for the respective ranges of mean neutron energies 0.75 MeV < $\hat{E}_n$ < 1.7 MeV and 1.3 MeV < $\hat{E}_n$ < 4.6 MeV. Combining these results with those from an earlier experiment it was verified that η is constant for 30 keV < $\hat{E}_n$ < 4.6 MeV, deviating by less than 1% from its average value in the range 1 MeV < $\hat{E}_n$ < 4.6 MeV. (auth)

14809 MULTIPARAMETER PHOTON DIFFERENCE ANALYSIS. Thies, H. H.; Crawford, D. M.; Boettcher, K.; (and others) (Univ. of Western Australia, Nedlands). Nucl. Instrum. Methods; 106: No. 2, 339-343(1973).

In an "energy sweeping" type photonuclear experiment using a multi BF_3 counter neutron detection system, the counts from the various counters may be recorded individually as a function of peak bremsstrahlung energy and counter position in a multiparameter storage system. The transformation calculation transforming this multiparameter information into the cross section is formulated and discussed. (auth)

14810 EVALUATING SEMICONDUCTOR RADIATION DETECTORS. Beckett, J. Process Instrum.; 1: No. 9, 431-432 (Dec 1972).

Methods of evaluating lithium-drifted germanium γ ray detectors are reviewed. It has been found that electron drift mobility in p type germanium crystals does not correlate with lithium ion drift mobility and cannot be used as a measure of crystal quality or of oxygen concentration. A new method of measurement of oxygen concentration however has the advantage of taking only three hours instead of the previous 100 hours. The first experimental determination of the upper limit of the Fano factor in germanium at NBS is described. An operational model for carrier trapping in Ge(Li) detectors was developed to simulate, on a digital computer, experimentally obtained gamma ray spectra in order to gain information on such parameters as electron and hole lifetimes. To aid those who fabricate, test, and use Ge(Li) detectors, a series of six nomographs was produced, covering calculations routinely used in fabrication and measuring detector quality. Additional research is also being progressed into an improved infrared response technique for determining defect and impurity levels in semiconductors. (UK)

14811 SATELLITE INSTRUMENT FOR MEASURING PROTONS IN THE ENERGY RANGE 0.1 MeV to 6 MeV. Soeraas, F. (Univ., Bergen); Aarsnes, K.; Lindalen, H. R.; Moehl Madsen, M. Arbok Univ. Bergen, Mat.-Natur. Ser.; 1970: No. 6, 23p.(1972).

Experiment S71C on board the ESRO I (Aurorae) satellite was designed to study both trapped and precipitating protons in the energy range 100 keV to 6 MeV at high latitudes and in the auroral zone, using three surface-barrier detectors. Both protons belonging to the radiation belt and transient phenomena such as solar and auroral protons were to be measured. Referring to the direction of the magnetic field line the detectors' orientations were $D_1(\theta = 0°)$, $D_2(\theta = 90°)$ and $D_3(\theta = 45°)$. A collimator restricted the opening angle to 16°30′ and magnets in front of the apertures swept away electrons with energies less than 500 keV. Both the sensor units and the amplifier and pulse height analyzer units are described in some detail. Finally, the energy calibration is described. (Norway)

14812 IMPROVED SCINTILLATION COCKTAIL OF HIGH-SOLUBILIZING POWER. Anderson, L. E.; McClure, W. O. (Univ. of Illinois, Urbana). Anal. Biochem.; 51: No. 1, 173-179(Jan 1973).

A scintillation solution containing 25% Triton X-114 in xylene is considered for a broad range of scintillation counting applications. The solution gives good counting efficiencies for ^{3}H (47%) and ^{14}C (93%). It will accept up to 30% (v/v) aqueous sample. The scintillation fluid is also used effectively with samples which are difficult to solubilize, such as the degradation products from the solubilization of polyacrylamide gels. The fluid can be formulated for less than $2.00 per gallon. (auth)

14813 DETERMINATION OF THE BATCHING CHARACTERISTICS OF INSTRUMENTS BY MEANS OF STANDARD SPECTROMETRIC GAMMA-SOURCES. Strakovskaya, R. Ya.; Gorbunova, S. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 688-691(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 66-69(1972).

A procedure is described for the measurement of the batching characteristics by means of an assembly of standard spectrometric γ-sources (s.s.g.s.). The use of s.s.g.s. considerably simplifies the determination of the "variation with hardness" of batching instruments. The results obtained coincide with the results obtained by other methods. (auth)

14814 LUMINESCENCE YIELD OF DISPERSIVE PHOSPHORS. Al'perovich, V. R.; Komyak, N. I.; Morgovskii, L. Ya. (Special Design Bureau of X-Ray Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 692-694(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 69-71(1972).

A formula is derived for determining the luminescence yield of dispersive phosphors under the action of x radiation. The experimental values of the luminescence yield of ZnS (Ag) phosphor (FS-4 grade) excited by FeK_α x radiation (6.4 keV) and by AgK_α x radiation (22.1 keV) are in good agreement with the results of calculations. The optimal (from the point of view of the maximum luminescence yield) thicknesses of ZnS (Ag) and NaI (Tl) phosphors are calculated in the energy range from 3 to 22 keV. This allows the range of feasible application of a particular detector in analog scintillation counters to be determined. (auth)

14815 SENSITIVITY OF COUNTERS FILLED WITH ^{3}He IN MEDIA CONTAINING HYDROGEN. Bogatyrev, V. K.; Dobovskii, B. G.; Frolov, V. V.; Charychanskii, V. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 695-697(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 72-73(1972).

Calculated and experimental data for the sensitivity of thermal-neutron counters filled with ^3He and situated in media containing hydrogen are presented. The flux depression caused by the strong absorptive properties of the counters is taken into account. (auth)

14816 AUTOMATIC MEASUREMENT OF THE ENERGY RESOLUTION OF SEMICONDUCTOR NUCLEAR-PARTICLE DETECTORS. Selyutin, V. P.; Nikitin, B. A.; Fedoseeva, O. P.; Finogenov, K. G. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 704-706(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 79-82(1972).

An installation is described for the automatic measurement of the dependence of the energy resolution of semiconductor nuclear-particle detectors on the detector voltage. The installation is distinguished by its simplicity and high speed. The results of a check of its applicability for monitoring the energy resolution of silicon detectors relative to α particles are presented. The time expended for recording the resolution in the 1 to 100 V range is ~1.5 min. The error of measurement of the energy resolution does not exceed ~10% of the measured quantity. The unit is convenient for massive measurements. (auth)

14817 PREAMPLIFIER FOR SIGNALS FROM SEMICONDUCTOR DETECTORS BASED ON FIELD-EFFECT TRANSISTORS. Golubev, Yu. A.; Pakhomov, E. E.; Polytsya, O. P. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 763-764(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 130-131(1972).

A low-noise preamplifier based on 2P303V transistors is described. The noise characteristics of the preamplifier are given as a function of the input capacitance for various time constants of the signal-shaping circuits. For shaping time constants of 4 μsec the noise characteristic of the preamplifier was 1.25 keV + 24 eV/pF (at room temperature). The described preamplifier was used to obtain a resolution of 3 keV for the 1.33 MeV line with a coaxial lithium-drift detector having a sensing volume of 28 cm^3. (auth)

14818 INVESTIGATION OF THE CHARACTERISTICS OF SILICON SURFACE-BARRIER ΔE DETECTORS FOR STUDYING NUCLEAR REACTIONS. Zorin, G. N.; Kushniruk, V. F. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 677-679(1972). Translated from Prib. Tekh. Eksp.; 15: No. 3, 57-59(1972).

A procedure is described for obtaining semiconductor surface-barrier ΔE-detectors 15 to 140 μ thick with a nonparalleiness of <0.5 μ on a diameter of 20 to 28 mm and with a working area of 0.2 to 1.5 cm^2. Experimental characteristics of such detectors are presented including volt–amp and volt-capacitance characteristics and energy resolution. It is shown that bias voltages may be applied to them which are 3 to 5 times in excess of the depletion voltage without degrading the spectrometric characteristics of the detector. (auth)

14819 SEMICONDUCTOR DETECTORS WHICH ARE SENSITIVE TO THE SPOT AT WHICH A PARTICLE STRIKES. Artemov, S. V.; Guner, M. A.; Il'yasov, A. Z.; (and others) (Inst. of Nuclear Physics, Tashkent, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 680-681(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 59-62(1972).

The technology of fabrication and the characteristics of Si (Li)-drift and surface-barrier detectors used in the recording systems of the "Apel'sin" magnetic analyzers are described. The length of the sensing surface of the detectors was 10 to 20 mm; the thickness of the sensing region reached 2 mm. The detectors had an energy resolution of 2 to 3%, and a coordinate resolution of 0.7 to 1.0 mm for a nonlinearity of at most 3 to 4%. (auth)

14820 PROTECTIVE COATING FOR SILICON SURFACE-BARRIER NUCLEAR-RADIATION DETECTORS. Kratsikova, I.; Son, L. C.; Thek, L. H.; Osipenko, B. P.; Permyakova, L. A. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 683-684(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 62-63(1972).

A new protective coating is proposed for silicon surface-barrier nuclear-radiation detectors (a saturated solution of rosin in ethyl alcohol). The coating leads to a considerable lowering of leakage currents and to an increase in the breakdown voltages. The principal advantages of the rosin coating are: low cost, simplicity of preparation and application, and absence of high-temperature treatment. (auth)

14821 EFFICIENT FAST-NEUTRON SCINTILLATION DETECTOR. Goryachev, B. I.; Kuznetsov, Yu. V.; Orlin, V. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 685-687 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 64-66(1972).

A liquid fast-neutron scintillation detector having a volume of 130 liters is described. The scintillator is fabricated on the basis of vaseline oil (liquid paraffin). The efficiency of the detector relative to spontaneous-fission neutrons is 40%. A method for measuring the energy sensitivity of the detector for neutrons which develop as a result of the photospallation of deuterium is presented. (auth)

Radiation Dosimeters

Refer also to abstracts 15336, 16110, 16140, and 16402.

14822 (BNWL-CC-485) INTERPRETATION OF DOSE FROM ^{16}N RADIATION WITH THE HANFORD FILM BADGE DOSIMETER. Nelson, I. C.; Baumgartner, W. V.; Faust, L. G. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). 31 Jan 1966. Contract AT(45-1)-1350. 4p. Dep. NTIS.

Personnel working close to recirculating coolant circuits in Hanford's production reactors often have dosimeter films that show an unusual darkening pattern. This unusual condition is attributed to exposure to high-energy radiation from ^{16}N, for which electronic equilibrium conditions are not met in the dosimeter. The film dosimetry was evaluated, and a method was developed to estimate the dose to individuals exposed to both radiation from ^{16}N and gamma rays of lower energy (but greater than 100 keV). From the data available so far, the method appears adequate. (1 figure, 1 table) (RWR)

14823 (CONF-721203-8) CONCLUDING SUMMARY OF SYMPOSIUM ON NEUTRON MONITORING FOR RADIATION PROTECTION PURPOSES. Auxier, J. A. (Oak Ridge National Lab., Tenn.). 1972. 8p. Dep. NTIS.

From Symposium on neutron monitoring for radiation protection purposes; Vienna, Austria (11 Dec 1972).

Topics of the conference are summarized including neutron spectroscopy; dose and dose equivalent; instruments and techniques for field monitoring; personnel monitoring (albedo detectors, dielectric track detectors, films and emulsions, sodium activation in the body, and threshold detectors); intercomparison experiments; and standardization and calibration techniques. (WHK)

14824 USE OF PHOTOFILMS FOR THE INDIVIDUALIZED RADIOMETRY OF THE DAUGHTER PRODUCTS OF RADON. Markov, K. P.; Ryabov, N. V.; Stas, K. N. Yadern. Priborostr.; No. 12, 184-91(1970). (In Russian).

The possibility was examined of obtaining individual controls on the air concentration of radon decay products from the size of the latent energy by pumping air through filters and simultaneous registration of the α activity of the samples by means of the ZnS(Ag) scintillator and photofilms. The results of theoretical and experimental studies on the sensitivity of the method and its range of applicability were reported. (3 figures) (tr-auth)

14825 SOLID STATE INTEGRATOR FOR A DIGITAL DOSEMETER. Kemplay, J. R. (Westminster Hospital, London). Brit. J. Radiol.; 45: No. 530, 153-155(Feb 1972).

A circuit is described which is capable of converting the ionization current of the monitoring chamber associated with a therapy machine into a string of pulses whose repetition frequency is proportional to the current. The principal parts of the circuit are an operational integrator, followed by a voltage comparator and switch. The output voltage ramp of the integrator changes at a rate directly proportional to the d-c input signal. At some predetermined level it causes the voltage comparator to produce an output signal; this operates the switch to bring about the discharge of the integrating capacitor. The discharge time of the capacitor is short, allowing the circuit to operate many times a second without loss of linearity. The circuit covers an input current range of 0.5 to 3 μA, but can be extended above 3 μA without modification and below 0.5 μA by substituting an alternative operational integrator. The linearity of response is excellent and insensitive to changes in ambient temperature. A digital dosimeter incorporating the integrator is being used with a 4 MeV linear accelerator for routine patient treatment. (UK)

14826 DOSIMETRIC CHARACTERISTICS OF PHOTORESISTORS. Sidorenko, V. V.; Demidovich, V. N.; Soroka, V. V.; Sidorenko, A. V.; Zharkov, S. A. (Leningrad Inst. of Aviation Instrumentation). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 353-356(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 49-51(1972).

Results are presented of experimental investigations of Soviet semiconductor nuclear radiation detectors of the RGD type based

on CdS, and FSD-1, FSK-1, FSK-2, and SF2-2 photoresistors; the possibility of using the devices in dosimetric equipment designed for recording γ radiation is evaluated. (5 figures, 1 table) (auth)

14827 THERMOLUMINESCENCE DOSIMETER. Kotera, Noboru; Sakamoto, Hitoshi (Dai Nippon Toryo Co. Ltd., Osaka). Hihakai Kensa; 21: No. 5, 283-289(May 1972). (In Japanese).

The development and use of thermoluminescent dosimeters for personnel and environmental monitoring are briefly discussed. Dosimeter elements and measuring instruments of the TLD 1200 system using Mg_2SiO_4 : Tb phosphors are described. (WHK)

14828 PRESENT SITUATION AND PROSPECT OF IRRADIATION DOSE MEASUREMENT. Higuchi, Kiyoji (Iwate Medical Coll., Morioka, Japan). Nippon Hoshasen Gijutsu Gakkai Zasshi; 27: No. 1, 1–22(Jun 1971). (In Japanese).

In radiation therapy, accurate measurement of irradiation dose is most important. Hence, in 1962, an investigation of the actual condition of dose measuring instruments in Japan was carried out. From 1963 to 1970, a comparison of scattered radiation detectors and telecobalt irradiation instruments was made. It was estimated that the number of dosimeters was about 1000 and that of pocket chambers was 3000. In order to investigate the accuracy of the scattered radiation detectors, 45 randomly sampled detectors were compared. Among them, the rate of out-of-order detectors was as much as 29%. Their troubles mostly arose from dc batteries, and the maximum fluctuation of calibrated dose was as large as 130%. It was decided that if detectors are maintained in good condition, the sensitivity scarcely changes for many years. 151 telecobalt irradiation instruments sampled from 397 were compared. The results were as follows: average deviation of curing doses from standard dose was 8.06% and the rate of instruments with a deviation of less than 10% was 74%. Correction for temperature and atmospheric pressure has never been carried out when measuring dose. It is concluded that an effort must be made so that every cobalt irradiation dose error may be limited to below 5%. (Japan)

14829 RECONSIDERATION ON PHOTOGRAPHIC METHOD FOR MEASURING DOSE DISTRIBUTION OF HIGH ENERGY X-RAYS. Onai, Yoshio; Tomaru, Teizo; Irifune, Toraji; Uchida, Isao (Japanese Foundation for Cancer Research, Tokyo). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 11, 1224-1236(Feb 1972). (In Japanese).

Quantitative comparison was made on the chamber and film for the depth dose measurement of ^{60}Co γ-rays, and 4.3 and 10 MV x-rays using Kodak Industrial Type M film (double emulsion) and Fujilith Contact film (single emulsion). The energy dependence of Fujilith Contact film was smaller than that of Kodak Type M film. For Kodak Type M film, the photographic depth dose percentage obtained with film parallel to the incident beam was higher than those with the film perpendicular to it, since there was a difference in the angular dependence of the film between shallow and deep depth in the phantom. As compared with ionization chamber measurements, photographic films indicated somewhat higher depth dose at considerably greater depths in the phantom, particularly for a large field. In the case of multiple field or moving field of high-energy x-rays, the photographic method was suitable for the region of greater than 50% of maximum dose. However, it is necessary to use the ionization chamber method besides the film method for the single field and the lower dose level of multiple field. (auth)

14830 CHARACTERISTICS OF A PERSONAL NEUTRON TRACK DOSIMETER. Keirim-Markus, I. B.; Koroleva, T. V.; Kraitor, S. N.; Uspenskii, L. N. At. Energ. (USSR); 34: No. 1, 11-15(Jan 1973). (In Russian).

The characteristics of a personal neutron dosimeter, consisting of track detectors of fission fragments from ^{237}Np beyond a 0.1 g/cm^2 ^{10}B filter and ^{235}U are investigated. The dose response was determined. The dependence of dosimeter readings on the distance from a human body surface and the radiation incidence angle were estimated. The measurement results for various neutron spectra are presented. It is shown that the dose response spread does not exceed 10 per cent. The experimental results agree with the calculated data. (4 figures, 2 tables, 14 references) (auth)

14831 KHIMICHESKIE METODY DOZIMETRII V RADIOBIOLOGII. (Chemical Methods of Dosimetry and Radiobiology). Sokolova, I. K. Moscow; Atomizdat (1972). 120p.

Fundamental dosimetry concepts and the chemical effects of radiation are reviewed, and chemical dosimeters are studied. Substances discussed for use as radiation-sensitive systems include ferrous sulfate, $Ce^{4+} \rightarrow Ce^{3+}$, Cr^{6+}, Tl^{3+}, Co^{3+}, V^{5+}, MnO_4^-, aqueous solutions of Ca benzoate, quinine, dyes, halogen derivatives of hydrocarbons, ($CHCl_3$), carbohydrates, 4-amino-1,2,4-triazole, polymers, glass, and certain gases (nitrous oxide). Dosimetry systems designed to measure x-radiation, γ-radiation, electrons, neutrons, and heavy charged particle fluxes are considered, and applications in radiobiology are discussed. (215 references) (KSW)

14832 FURTHER STUDIES ON TSEE ACTIVATORS IN BeO. Moreno y Moreno, A.; Cheka, J. S.; Nagpal, J. S.; Gammage, R. B.; Becker, K. (Oak Ridge National Lab., TN). Rev. Mex. Fis.; 21: No. 2, 123-138(1972).

In a continuing effort to study and improve the dosimetric characteristics of TSEE detectors, in particular of ceramic BeO:Si (which was shown in previous studies to be a promising material), the effect of modified readout techniques and of other potential activators was studied. In some cases, the surface was impregnated with compounds of such elements as Li, B, and Mn prior to firing; in others, the compounds (MgO, CaO, Al_2O_3) were added in varying amounts prior to the fabrication of the ceramics. Also, BeO ceramics with a varying SiO_2 content were prepared; and the properties, compared to those of natural Be compounds (phenacite). The results are briefly described and discussed. (11 figures) (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstract 14951.

14833 (CALT-767-P-11-X-3) STUDY OF DEEP LEVELS IN DETECTOR-GRADE GERMANIUM BY CHARGE TRANSPORT TECHNIQUES. Report No. 4. Marrello, V.; Ottaviani, G.; Mayer, J. W.; Nicolet, M.-A. (California Inst. of Tech., Pasadena. Dept. of Electrical Engineering). 30 Aug 1972. Contract AT(04-3)-767. 15p. Dep. NTIS.

Solid-phase regrowth processing has been used to fabricate large area (5 cm^2), thin p^+-contacts on high purity germanium. Evaporated Al layers on Ge were heated at 300°C and slow-cooled to form the p^+-contacts. The n^+-contacts were formed by lithium diffusion. Detector resolutions of $\lesssim$1 keV for ^{57}Co and ~2 keV for ^{60}Co are comparable to those obtained with Ge(Li) detectors of similar size with the same electronic system. (auth)

14834 (JINR-P10-6818) EXPRESS-PROGRAM FOR SPECTRUM PROCESSING EPOS, DESCRIPTION OF THE PROCEDURES OF SPECTRUM CONSTRUCTION, PEAK SEARCH, DIVIDING OF THE SPECTRUM IN PARTS, BACKGROUND PARAMETER DETERMINATION. Oehler, H.; Gopych, P. M.; Vinel, G. V.; Habenicht, W.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 13p. (In Russian). Dep. NTIS (U. S. Sales Only).

The purpose and operating principles of four procedures of the first part of the EPOS program are briefly described. By using these procedures the automatism in spectrum processing is achieved. (auth)

14835 (JINR-P10-6819) EXPRESS-PROGRAM FOR SPECTRUM PROCESSING EPOS, DESCRIPTION OF THE PROCEDURES OF THE AMPLITUDE PEAK DETERMINATION, DEFINITION OF THE AUTOMATIC CORRESPONDENCE BETWEEN THE CALIBRATION ENERGIES AND THE SPECTRUM LINES, DEFINITION OF THE PRELIMINARY ENERGY CALIBRATION AND OF THE PRELIMINARY ESTIMATE OF ERRORS IN ENERGY AND LINE INTENSITY. Oehler, H.; Gopych, P. M.; Vinel, G. V.; Habenicht, W.; Vylova, L. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only).

A description of the purpose and operating principle of the EPOS-1 program procedures is presented. By using these procedures the automatism in spectrum processing is achieved. An example is presented of the experimental spectrum processing with the help of the EPOS-1 program. (auth)

14836 (LA-DC-72-1460) REAL TIME PROGRAMMING SYSTEM FOR A COMPUTER-BASED PULSE HEIGHT ANALYZER. East, L. V. (Los Alamos Scientific Lab., N. Mex.). 1972. 4p. (CONF-721047-3). Dep. NTIS.

From 3rd symposium on stored program controllers; Los Alamos, NM (16 Oct 1972).

A programming system incorporating a modified FOCAL interpreter for a PDP-9L computer-based pulse height analysis system is described. User programs written in the FOCAL language may be used to control data acquisition and perform data analysis. A switch panel and large screen display with a light pen are utilized to give the user a high degree of interaction with the software. (auth)

14837 (ORO-3820-21) ON-LINE ALPHA AND PROTON DECAY SPECTROMETRY. Annual Progress Report, 1972. Macfarlane, R. D. (Texas Agricultural and Mechanical Univ.,

College Station. Cyclotron Inst.). 15 Jan 1973. Contract AT(40-1)-3820. 18p. Dep. NTIS.

Most of the work centered on the question of the beta-decay mirror symmetry in the mass-20 multiplet and the He-jet recoil method. Summaries of a number of journal papers are presented. Work in progress involves the development and performance of the MAGGIE recoil-time-of-flight mass spectrometer. (3 figures) (RWR)

14838 REACTION (e,e′α). Abe, K. (Tohoku Univ., Sendai); Tsubota, H.; Kawamura, N. (Kakuriken Kenkyu Hokoku; 3: No. 2, 34-7(Dec 1970). (In Japanese).

A system with a particle identifier was designed and tested to observe alpha particles for the purpose of studying light nuclei. The alpha particles were produced by the reaction (e,e′α) with a betatron and an electron linear accelerator. Large improvement of present experimental devices was made for a scattering chamber and its surrounding to reduce background counts. The scattering chamber was surrounded by water tanks, lead blocks and paraffin blocks. A 2 mm solid state detector was used for the detection of alpha particles. Successful results were obtained except particle yield from targets. Another scattering chamber was designed and employed. Ratio of the counts with a target and without the target was 10:1. The shielding arrangement was investigated and the ratio of counts was somewhat improved, but not to 100:1. A dE/dx – E telescope is considered as a detection system for the next experiment. (Japan)

14839 NEW HYBRID SPECTROMETER FOR INELASTIC THERMAL NEUTRON SCATTERING. Kleb, R.; Ostrowski, G. E.; Price, D. L.; Rowe, J. M. (Argonne National Lab., IL). Nucl. Instrum. Methods; 106: No. 2, 221-230(1973).

A new thermal neutron spectrometer has been installed at the CP-5 reactor at Argonne. The instrument is intended mainly for the study of inelastic scattering from isotropic systems, and consists of a double crystal assembly for producing a monochromatic incident beam and a multiple-detector time-of-flight system for energy and momentum transfer analysis of the scattered beam. A brief description of the facility is given, and the reasons leading to the choice of this type of instrument, the incorporation of a number of special features and the specification of parameters for the various components are discussed. Performance is described in terms of resolution and intensity. (auth)

14840 DETECTION AT 0^0 OF CHARGED PARTICLES FROM NUCLEAR REACTIONS USING A MAGNETIC SPECTROMETER. Calvert, J. M.; Critchley, J. B. (Univ. of Manchester, Eng.). Nucl. Instrum. Methods; 106: No. 2, 263-267(1973).

A magnetic analyzer has been used to detect particles at 0° from nuclear reactions, the primary beam being stopped inside the analyzer. Some of the problems encountered are discussed. One of these was the identification of multiply charged heavy ions of relatively high energy in small amounts as contaminants in the deuterium beam which was obtained from a Van de Graaff accelerator. (auth)

14841 NARROWING OF THE 14 keV MOESSBAUER EMISSION LINE OF ^{57}Fe BY FILTERING. Carrell, J. C. (Southern Illinois Univ., Carbondale). Nucl. Instrum. Methods; 106: No. 2, 275-278(1973).

Increased resolution has been achieved by narrowing the emission line of ^{57}Fe. The 14 keV gamma emitted from a ^{57}Co source in a copper matrix has been selectively absorbed yielding a narrowing of 41.6% relative to the source width. (auth)

14842 PARTIAL DECONVOLUTION AS A MEANS OF STUDYING THE LIMITATIONS ON RESOLUTION OF SPECTRA IMPOSED BY NOISE. Bronk, B. V. (Brookhaven National Lab., Upton, NY); Whitten, W. B. Nucl. Instrum. Methods; 106: No. 2, 319-331(1973).

The effect of a finite slit on measurement of spectra is represented by the convolution operation which is defined in terms of a polynomial of an elementary matrix. Partial deconvolution is rigorously defined on the basis of this development. Methods are developed for finding the optimal degree of convolution in order to find the best balance between resolution and magnification of noise in terms of a partial deconvolution. It is shown that the mathematical properties of slit functions are the factors leading to a "quasiperiodicity" of resolved noise. Various examples of known spectra are resolved after addition of noise or observation through a non-ideal slit. It is shown that foreknowledge of the existence of quasiperiodicity together with the properties of partial deconvolution can be used in a rapid and simple way in order to obtain a much improved effective final resolution of spectra. (auth)

14843 RESOLUTION FUNCTION OF A TRIPLE-AXIS NEUTRON SPECTROMETER. Brabcev, B. (Inst. for Atomic Physics, Bucharest). Nucl. Instrum. Methods; 106: No. 2, 349-355 (1973).

The amplitude and the shape of the resolution function of a triple-axis neutron spectrometer are calculated in the Gaussian approximation. Formulae containing the explicit analytical dependence of the resolution function on the incoming and scattered neutron wave vectors as well as on instrumental parameters in forms suitable for computation are obtained. The case of the double-crystal monochromator is also treated. (auth)

14844 ION-DOPED SEMICONDUCTOR SPECTROMETRIC DETECTOR. Vinogradova, V. G.; Gverdtsiteli, I. G.; Guldamashvili, A. I.; Golubkov, V. B. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 343-345(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 41-43(1972).

An ion-doped spectrometric α-particle and proton detector based on x-type silicon is described. Its volt–ampere and radiometric characteristics are presented. By using a detector having an area 230 mm^2 at room temperature, a resolving power of 45 keV was achieved for 5.286-MeV α particles, while a value of 30 keV was obtained for 500-keV protons. (2 figures, 1 table) (auth)

14845 SEMICONDUCTOR GAMMA-SPECTROMETERS WITH SUPPRESSION OF THE COMPTON-SCATTERING CONTRIBUTION (REVIEW). Shipilov, V. I. (Scientific Research Inst. of Atomic Reactors, Melekess, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 305-318(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 7-19(1972).

In γ spectrometry with semiconductor detectors weak low-energy γ lines are difficult to observe against the background of the intense Compton contribution from high-energy γ quanta. The suppression of the signals produced by Compton scattering of γ quanta helps in the identification and quantitative determination of isotopes. Methods of reducing the contribution from Compton scattering are considered: pulse-shape discrimination on the detector pulse; anti-Compton, pair, and Compton spectrometers; summing Compton spectrometers; and spectrometers based on multiple Compton interaction. (21 figures, 64 references) (auth)

14846 STILBENE SCINTILLATION SPECTROMETER AS A MIXED NEUTRON–GAMMA RADIATION DOSIMETER. Kovalev, V. P.; Kapchigashev, S. P.; Pavlov, L. P. At. Energ. (USSR); 34: No. 1, 7-10(Jan 1973). (In Russian).

The possibility of using a stilbene scintillation spectrometer for neutron and gamma dosimetry in mixed radiation fields was investigated. Measurements were made to determine the radiation characteristics of a Pu–Be neutron source and a source of mixed radiation from a linac. It is shown that the use of a 50-cm iron shield results in the creation of a radiation field in which the magnitude of the neutron component is equal to twice that of the gamma component. (4 figures, 2 tables, 7 references) (auth)

14847 USE OF AN AMPLITUDE ANALYZER FOR DETERMINING THE RESOLVING POWER OF SEMICONDUCTOR COUNTERS. Eremin, V. K.; Lomashevich, S. A.; Strokan, N. B.; Tisnek, N. I. (Physical-Technical Inst., Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 698-700(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 74-76(1972).

A method is described for calculating the shape of the amplitude spectrum of semiconductor γ-quantum counters. The method is based on the scheme developed for plotting the spectra, which uses the notion of a response function. It is shown that the use of an amplitude analyzer allows avoidance of the use of an electronic computer and permits amplitude spectra that take into account the effect of ionization fluctuations and equipment and counter noise, as well as the nonuniformities of the charge losses to be obtained in a clearly depictable form. (auth)

14848 SOURCE OF REFERENCE SIGNALS FOR STABILIZING SCINTILLATION GAMMA SPECTROMETERS. Shein, S. A.; Karasik, A. S. (Natural-Science Inst., Perm, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 701-703(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 77-79(1972).

A simple thermally stable circuit is described for a source of reference signals for stabilizing scintillation γ spectrometers. The circuit is designed using four-layer 2N102B switching diodes and a KL-101V luminescent diode. The proposed circuit provides for temperature compensation of the scintillator and ensures temperature stability of the readings of the scintillation γ spectrometer of at worst 0.03%/°C. (auth)

High Energy Physics Instrumentation

Refer also to abstracts 14932, 14933, 14955, 14959, 15612, 16126, and 16224.

14849 (CEAL-3063-4) MAGNOLIA DETECTOR: SUMMARY REPORT. Bailey, B.; Bolon, C.; Lanza, R.; (and others) (Cambridge Electron Accelerator, Mass.). Dec 1972. Contract AT(11-1)-3069. 81p. Dep. NTIS.

The design, performance, and status of the Magnolia detector are described. The magnetic spectrometer consists of proportional counters for triggering, spark chambers serving as momentum chambers, and spark chamber and radiator arrays serving as shower counters, all within a rectangular solenoidal coil. The detector has a large angle of acceptance and some capability for photon detection as well as pion and electron separation by means of shower chambers The detector has the capability for charged particle detection throughout 3.7 π steradians (23° to 157° from beam axis). Possible experiments are discussed including unusual decays of K^+, $p + \bar{p}$ annihilation, vertex detection, and study of K^0_2 decay. The labor and cost for completion are tabulated, and a summary description of work remaining to be done is given. (WHK)

14850 (CERN-72-21, pp 275-340) OMEGA PROJECT: A CASE HISTORY IN THE DESIGN AND IMPLEMENTATION OF AN ON-LINE DATA ACQUISITION SYSTEM. Russell, R. D. (CERN, Geneva). 1 Dec 1972.

The Omega Project is concerned with the construction of a large-aperture spectrometer of very broad utility. Because of the long design lifetime of the instrument, the specifications were kept as flexible as possible. The historical evolution of the Omega computing system is considered first, with emphasis on the problems that occurred and the decisions that had to be made during the years ending with 1972. Technical aspects of the Omega data handling system are then discussed. The present configuration is a hierarchy of one medium computer, two small computers, and four minicomputers. The following aspects of the data handling system are considered: the data links (the concept, the user interface, the link dialogue, and the link hardware), Omega graphics, histogramming facilities, consequences of the multicomputer hierarchy, and the minicomputers (the on-line monitor, programming languages). (12 figures, 7 tables) (RWR)

14851 (CERN-72-21, pp 407-422) CASE HISTORY: A HIGH-ENERGY PHYSICS EXPERIMENT. Conetti, S. (CERN, Geneva. Univ., Trieste, Italy. Istituto Nazionale di Fisica Nucleare, Trieste, Italy). 1 Dec 1972.

The various roles that an on-line computer must play in a high-energy physics experiment are briefly discussed. Then an experiment to measure the polarization parameter for the reactions $\pi^+p\uparrow \rightarrow p\pi^+$, $K^+p\uparrow \rightarrow pK^+$, and $\pi^+p\uparrow \rightarrow \Sigma^+K^+$ is described. The general setup of the experiment is considered first, and then the on-line system is treated in some detail; hardware configuration, software configuration, data acquisition, data transfer, data analysis, process control, and communications with the user are examined. (6 figures, 4 tables) (RWR)

14852 (JINR-D1-6349, pp 624-31) HIGH RESOLUTION PROTON SPECTROMETER (HRS) AT LAMPF. Igo, G. (Univ. of California, Los Angeles); Tanaka, N.; Thiessen, H. A.

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The properties of the LAMPF high-resolution proton spectrometer (HRS), the status of construction, and some of the initial proposals by user's groups for experiments at the HRS are discussed. (L.B.S.)

14853 (JINR-D10-6142) PROCEEDINGS OF THE INTERNATIONAL SYMPOSIUM ON DATA HANDLING OF BUBBLE AND SPARK CHAMBERS, DUBNA, OCTOBER 12-16, 1972. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 564p. (In Russian and English). (CONF-711061).

The 46 papers presented are title listed in NSA. (WHK)

For titles of individual papers see: 14854-14899.

14854 (JINR-D10-6142, pp 7-37) FILM TRANSPORT AND PROGRAMMING SYSTEM OF COCCINELLE AND ITS APPLICATION TO THE PROCESSING OF MIRABELLE PICTURES. Equer, B.; Fontaine, G.; Marchand, D.; Narjoux, J. L. (Coll. de France, Paris).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14855 (JINR-D10-6142, pp 38-67) GARGEMELLE SCANNING AND MEASURING TABLE. Bard, A.; Bernaudin, P.; Bosshard, R.; Cardenas, J.; Martinovitch, J.; Roue, J.; Truong Thanh, K.; Veillet, J. J.; Zajde, C. (Laboratoire de l'Accelerateur Lineaire, Orsay, France).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14856 (JINR-D10-6142, pp 68-84) CONTROL OF THE ADAM + EVA SYSTEM. Altaber, J. L.; Chanel, G.; Clayton, M.; Dodd, W. P.; Fucci, A.; Mazzari, C.; Stuerzinger, P.; Verkerk, C.; Wiskott, D. (CERN, Geneva).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14857 (JINR-D10-6142, pp 85-92) SYSTEMS FOR SCANNING AND MEASUREMENT OF PHOTOGRAPHS FROM THE MIRABELLE CHAMBER USING THE PUOS-2 PROJECTOR. Govorun, V. N.; Gorichev, P. A.; Delyunov, N. F.; (and others) (Inst. of High Energy Physics, Serpukhov, USSR). (In Russian).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14858 (JINR-D10-6142, pp 93-128) POLLY III: A FOUR-VIEW SYSTEM FOR ANALYZING FILM FROM LARGE BUBBLE CHAMBERS. Beck, F. (Argonne National Lab., IL).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14859 (JINR-D10-6142, pp 129-50) ERASME: A SCANNING AND MEASURING SYSTEM FOR LARGE BUBBLE CHAMBER PHOTOGRAPHS.

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14860 (JINR-D10-6142, pp 151-7) ELECTRON RAY SCANNING SYSTEM FOR MEASUREMENT OF PHOTOGRAPHS FROM BUBBLE CHAMBERS. Berlin, N. I.; Vertlib, I. L.; Gorelov, A. A.; Kats, B. M.; Markovich, M. G.; Ovchinnikov, E. K.; Rubchinskii, S. M.; Uvarov, V. A.; Tsukkerman, I. I. (Radiotechnology Inst., Moscow). (In Russian).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14861 (JINR-D10-6142, pp 159-69) SYSTEM FOR PROCESSING FILM INFORMATION. Zhurkin, V. V.; Ivanov, L. V.; Kaspin, A. I.; (and others) (Inst. of Theoretical and Experimental Physics, Moscow). (In Russian).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14862 (JINR-D10-6142, pp 170-88) SYSTEM FOR PROCESSING PHOTOGRAPHS FROM TRACK CHAMBERS. Baehr, J.; Boettcher, H.; Giese, P.; (and others) (Inst. for High Energy Physics, Berlin). (In Russian).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14863 (JINR-D10-6142, pp 189-202) BUBBLE CHAMBER FILM MEASUREMENTS PROCESSED WITH SOLAS. Baehr, J.; Boettcher, H.; Giese, P.; (and others) (Inst. for High Energy Physics, Berlin).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14864 (JINR-D10-6142, pp 203-12) DIGITIZING DEVICE FOR PREMEASUREMENT OF BUBBLE CHAMBER FILMS BASED ON SONIC WAVES PROPAGATION TIME. Bosshard, R.; Truong Thanh, K.; Zajde, C. (Ecole Normale Superieure, Orsay, France).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14865 (JINR-D10-6142, pp 213-26) LARGE SCANNING-MEASURING TABLES ON LINE WITH THE TRA COMPUTER. Almazov, V. Ya.; Belyakov, V. N.; Ermolaev, V. V.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14866 (JINR-D10-6142, pp 227-32) MEASURING DEVICE WITH OBJECTIVE ALIGNMENT. Dobyrn, V. V.; Ermakov, K. N.; Platunin, A. I.; Rodd, T. Ya.; Stabnikov, M. V. (Inst. of Nuclear Physics, Leningrad). (In Russian).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14867 (JINR-D10-6142, pp 233-9) SYSTEM FOR PROCESSING PHOTOGRAPHS FROM THE TWO-METER PROPANE CHAMBER AT IHEP. Ammosov, V. V.; Gerdyukov, L. N.; Gorichev, P. A.; (and others) (Inst. of High Energy Physics, Serpukhov, USSR). (In Russian).

From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14868 (JINR-D10-6142, pp 240-7) OPERATION OF THE SPIRAL MEASURING DEVICE AT JINR. Astakhov, A. Ya.;

Bulanova, G. N.; Vattenbakh, K.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14869 (JINR-D10-6142, pp 248-72) BRUSH: A ZERO-GUIDANCE SYSTEM WITH ON-LINE HPD ANALYSIS. Flavell, A. J.; Gandini, F.; Ruediger, A.; Schilling, R.; Schnupp, L. (Max-Planck-Institut fuer Physik und Astrophysik, Munich).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14870 (JINR-D10-6142, pp 273-80) BASIC FEATURES OF THE HPD-MARK-2A ELECTRONIC SYSTEM AT IHEP. Borovikov, A. A.; Gerasimov, B. Ya.; Zaitsev, L. F.; Ivanov, A. A.; Ivchenko, V. E.; Proskuryakov, Yu. T.; Khromova, G. N.; Yakovleva, T. G. (Inst. of High Energy Physics, Serpukhov, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14871 (JINR-D10-6142, pp 281-94) SCANNING AND MEASURING EQUIPMENT SAULE. Ovsov, Yu. V.; Noskov, Yu. G.; Magonov, G. M.; Rudenchenko, E. V.; Khalikova, G. M.; Kushulun, A. I.; Semenova, V. N. (Inst. of High Energy Physics, Alma-Ata, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14872 (JINR-D10-6142, pp 295-308) RAMSES: AN ON-LINE SYSTEM FOR SCANNING, MEASUREMENT, AND RECONSTRUCTION OF BUBBLE CHAMBER FILM. Burmeister, H.; Grung, B.; Norton, A. R.; Sletten, H. I. (CERN, Geneva).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14873 (JINR-D10-6142, pp 309-15) PROGRAM FOR AUTOMATIC PROCESSING OF PHOTOGRAPHS OBTAINED BY THE 1.5-METER FAST SPECTROMETER. Illarionova, N. M.; Il'kov, L. V.; Lipkin, I. M.; Ol'shanetskii, M. A.; Razinkova, T. L.; Tolchenkova, T. D. (Inst. of Theoretical and Experimental Physics, Moscow). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14874 (JINR-D10-6142, pp 316-41) PROGRAM FOR PROCESSING PHOTOGRAPHS OF THE THREE-METER MAGNETIC SPECTROMETER WITH SPARK CHAMBERS ON THE AUTOMATIC FACILITY PSP-1 (HPD TYPE) ITEP. Borodina, I. N.; Dzhelyadin, R. I.; Ivanov, L. V.; Kishkurno, V. V.; Krutenkova, A. P.; Kulikov, V. V.; Lyulevich, V. I.; Polikarpov, V. M.; Fedotov, O. P. (Inst. of Theoretical and Experimental Physics, Moscow). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14875 (JINR-D10-6142, pp 342-51) PHOTOGRAPH PROCESSING WITH A SEMI-AUTOMATIC MEASURING SYSTEM ON LINE WITH THE BESM-4. Ermolaev, V. V.; Ivanchenko, Z. M.; Kuznetsova, E. S.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14876 (JINR-D10-6142, pp 352-4) MULTILEVEL INTEGRAL ANALYZER FOR IONISATION MEASUREMENTS IN BUBBLE CHAMBER. Batagui, M. (Inst. of Atomic Physics, Bucharest).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14877 (JINR-D10-6142, pp 355-60) PARTICLE IDENTIFICATION WITH A SEMI-AUTOMATIC TELEVISED MEASURING DEVICE. Boos, E. G.; Zaitsev, K. G.; Mukhordova, T. I.; Ovsov, Yu. V.; Rudenchenko, E. V.; San'ko, L. A. (Inst. of High Energy Physics, Alma-Ata, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14878 (JINR-D10-6142, pp 361-5) PHOTOGRAPH PROCESSING FROM SPARK CHAMBERS USING THE SEMI-AUTOMATIC EQUIPMENT PIF-1. Vzorov, I. K.; Glonti, L. N.; Kazarinov, Yu. M.; Kuznetsov, A. S.; Sinaev, A. N.; Frolov, N. S.; Shuravin, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14879 (JINR-D10-6142, pp 366-72) PROCESSING OF PHOTOGRAPHS FROM SPARK CHAMBER PK-200 JINR USING A "TRACK" ARRANGEMENT. Budagov, Yu. A.; Vinogradov, V. B. Volod'ko, A. G.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14880 (JINR-D10-6142, pp 373-88) AUTOMATIC SCANNING FOR SMALL ANGLE SCATTERS. Howie, J. M. (CERN, Geneva).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14881 (JINR-D10-6142, pp 389-93) HPD ZERO-GUIDANCE WITH A SMALL ANGLE ELASTIC SCATTERING EXPERIMENT. de Boer, R. J. (Univ., Amsterdam); Harting, D.; van Leeuwen, W. M.; Meyer, R. W.; Tenner, A. G.; Vons, P.; Winzeler, H.
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14882 (JINR-D10-6142, pp 394-7) "TRACK-MATCH" METHOD FOR ANALYZING EVENTS RECORDED ON TWO STEREO-PHOTOGRAPHS. Buzdavina, N. A.; Ivanov, V. G.; Lebedev, R. M. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14883 (JINR-D10-6142, pp 398-411) DATA PROCESSING FROM TRACK CHAMBERS (JINR) WITH THE BESM-6 COMPUTER. Buzdavina, N. A.; Govorun, N. N.; Dorzh, L.; Zaikina, A. G.; Ivanov, V. G.; Karval'o, Zh.; Lepilova, L. I.; Luk'yantsev, A. F. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14884 (JINR-D10-6142, pp 412-18) PROGRAM OF GEOMETRIC RECONSTRUCTION "I-7". Markova, N. F.; Moroz, V. I.; Nikitina, V. I.; Stel'makh, A. P.; Tentyukova, G. N. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14885 (JINR-D10-6142, pp 420-8) OFF-LINE PROGRAM FOR PROCESSING SPIRAL SCANNING DATA. Komolova, V. E.; Kosareva, Z. M.; Kulyukina, L. A.; Ososkov, G. A. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14886 (JINR-D10-6142, pp 429-34) PRELIMINARY OUTLINE OF PROGRAMS AND PHYSICAL METHODS. Adushkina, R. I.; Vaisfel'd, A. M.; Zinov'eva, O. G.; Koltunov, I. A.; Lyubarskii, G. Ya.; Rovinskaya, A. M. (Physical-Technical Inst., Kharkov). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14887 (JINR-D10-6142, pp 435-8) METHODS FOR CONSERVING MACHINE TIME IN CALCULATION WHILE PROCESSING CHAMBER PHOTOGRAPHS. Vatset, P. I.; Koltunov, I. A.; Lyubarskii, G. Ya. (Physical-Technical Inst., Kharkov). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14888 (JINR-D10-6142, pp 439-47) SCANNING-MEASURING DEVICES FOR A COMPUTER DURING PROCESSING OF CHAMBER PHOTOGRAPHS. Astakhov, A. Ya.; Ermolaev, V. V.; Inkin, V. D.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14889 (JINR-D10-6142, pp 448-76) HOLOGRAPHIC APPARATUS AND POSSIBLE MEANS OF PROCESSING THE INFORMATION OBTAINED. Stabnikov, M. V. (Inst. of Nuclear Physics, Leningrad). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14890 (JINR-D10-6142, pp 477-80) INVESTIGATION OF NODES IN MODEL SIMULATION IN ELECTRON RAY TUBES FOR PROCESSING OF PHOTOGRAPHS FROM BUBBLE CHAMBERS. Kryutchenko, E. V.; Nikitin, S. G.; Sokolov, S. N.; Utechkin, B. A.; Khamaza, A. I. (Inst. of High Energy Physics, Serpukhov, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14891 (JINR-D10-6142, pp 481-94) PHOTOGRAMMETRIC MEASUREMENTS AND CORRECTIONS OF DISTORTION IN

STEREOPHOTOGRAPHS. Rusinov, M. M.; Livshits, E. M. (Leningrad Inst. of Precision Mechanics and Optics). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14892 (JINR-D10-6142, pp 495-501) INITIAL OPTICAL PROCESSING OF PHOTOGRAPHS FROM TRACK CHAMBERS. Kul'beda, V. E.; Rubchinskii, S. M.; Tverdokhlebov, A. S. (Radiotechnical Inst., Moscow). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14893 (JINR-D10-6142, pp 502-8) FOLLOWING A THREE-DIMENSIONAL TRACK DURING FRAME SCANNING. Erglis, K. E.; Kul'beda, V. E.; Kurov, V. M. (Radiotechnical Inst., Moscow). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14894 (JINR-D10-6142, pp 509-18) AUTOMATIC DISCRIMINATION OF THE APEX OF STARS AND IDENTIFICATION OF TRACKS ON PHOTOGRAPHS FROM BUBBLE CHAMBERS BY A METHOD OF THREE-DIMENSIONAL SCANNING AND TRACKING. Erglis, K. E. (Radiotechnical Inst., Moscow). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14895 (JINR-D10-6142, pp 519-24) OPTICO-MECHANICAL SINGLE-MIRROR UNIT FOR LIGHT BEAM DEFLECTION. Igoshina, L. A.; Kol'tsov, I. M.; Mamaev, V. L.; Rozov, B. S. (Moscow Engineering-Physics Inst.). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14896 (JINR-D10-6142, pp 525-35) APPLICATION OF THE METHOD OF RESOLVING FUNCTIONS FOR RECOGNITION OF GEOMETRIC IMAGES ON PHOTOGRAPHS FROM MAGNETIC SPARK SPECTROMETERS. Govorun, N. N.; Dikusar, N. D. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14897 (JINR-D10-6142, pp 536-41) TRANSDUCERS FOR LINEAR SHIFTS BASED ON HOLOGRAPHIC PRINCIPLES. Dobyrn, V. V.; Turukhano, B. G.; Turukhano, N. (Inst. of Nuclear Physics, Leningrad). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14898 (JINR-D10-6142, pp 542-6) METHODS OF DETECTING DISCONTINUITIES AND THE DETERMINATION OF THE KINEMATIC PARAMETERS OF PARTICLES IN A BUBBLE CHAMBER. Emel'yanenko, G. A. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14899 (JINR-D10-6142, pp 547-60) HYDRA: MODULAR PROGRAMS FOR BUBBLE CHAMBER DATA ANALYSIS. Boeck, R. K.; Eruyant, F.; Burmeister, H.; Norton, A.; Pagiola, E.; Porte, J. P.; Zoll, J.
From International symposium on data handling of bubble and spark chambers; Dubna, USSR (12 Oct 1971).

14900 (JINR-E13-6658) ON-LINE MAGNETOSTRICTIVE SPARK CHAMBER SYSTEM USED IN A PION-ELECTRON SCATTERING EXPERIMENT AT 50 GeV/c. Adylov, G. T.; Aliev, F. K.; Filippov, P. I.; (and others) (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 24p. Dep. NTIS (U. S. Sales Only).
A system of 18 magnetostrictive spark chambers online to a HP2116B computer used to probe the electromagnetic structure of the pi-meson is described. Sizes of spark chambers were chosen 250×250 mm^2 and 420×600 mm^2 each with an 8 mm gap. The spatial accuracy was ±0.4 mm in the X plane and ±0.3 mm for the Y plane. The efficiency of these chambers was greater than 90%. (auth)

14901 (JINR-P13-6607) COMPUTER SIMULATION OF THE DISCRETE ANALOG OF THE DIFFRACTION GRATING WITH RULING JUMP. Soroko, L. M.; Strizh, T. A.; Suetin, V. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).
The properties of a diffraction grating with ruling jump, intended to display and process optical information through the Hilbert transformation, are analyzed. Unusual properties of the diffraction grating with ruling jump are deduced both analytically and with the help of a computer. (8 figures) (auth)

14902 (KFK-1692) CONSIDERATIONS TO A 4-GAP-PION-SPECTROMETER FOR THE SIN. Jung, V. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Oct 1972. 13p. (In German). Dep. NTIS (U. S. Sales Only).
For the beam πM1 of the SIN isochronous ring cyclotron a pion-spectrometer has to be built. The maximum energy of the pions to be analyzed should be 450 MeV. For a 1 m curvature radius of the pion track, a field of 15 kG has to be reached. Smaller radii diminuate the resolving power of the spectrometer and are not tolerable for the needed high field accuracy of 10^{-4} to 10^{-5} which cannot be reached at higher field values. A bigger radius would enhance the resolving power but also increase the weight and price of the spectrometer. It is shown that a one-sector-spectrometer does not reach sufficient resolution. Separating of the functions of bending and focussing enables one to increase the resolution by a factor 2.5 by eliminating most of the second order aberrations. Further improvement of the resolving power only is possible by dividing the bending field into two or more sections with additional correcting multipoles (e.g., QDDD-spectrometer). (auth)

14903 (UH-511-139-72) TRANSITION RADIATION AND PARTICLE IDENTIFICATION. Parker, S. I. (Hawaii Univ., Honolulu). Sep 1972. Contract AT(04-3)-511. 10p. (CONF-720923-10). Dep. NTIS.
From 16th international conference on high energy physics; Chicago, IL (6 Sep 1972).
The production of transition radiation and a brief history of transition radiation are outlined. The operation of transition radiation detectors is reviewed, and the radiators and detectors used are discussed. Uses of transition radiation detectors for high energy particle discrimination are mentioned. (WHK)

14904 TRACK STORAGE IN A WIDE GAP SPARK CHAMBER FOR A TIME UP TO 1 ms. Asatiani, T. L.; Ivanov, V. A.; Ivanov, V. A.; Krishchian, V. M. (Yerevan Physical Inst., Moscow). Nucl. Instrum. Methods; 106: No. 2, 333-337(1973).
The possibility of track storage in track chambers is considered. It is shown that with pure Ne as well as with mixtures of Ne + (Ar, Kr, Xe) good quality tracks can be obtained in wide gap spark chambers for a delay time up to 1 ms by applying two high-voltage pulses successively to the chamber. (auth)

14905 PULSING OF STREAMER CHAMBERS. Rice-Evans, P.; Hassairi, I. (London Univ.). Nucl. Instrum. Methods; 106: No. 2, 345-347(1973).
A Lecher's wires arrangement has been used to pulse a streamer chamber. The resulting tracks of charged particles display a constant brightness and a uniform shape. (auth)

14906 COMPACT EHT POWER SUPPLY FOR USE WITH HIGH PULSE RATE SPARK CHAMBERS. Connolly, J. F.; Gilby, A. S. (Rutherford High Energy Lab., Chilton, Eng.). Nucl. Instrum. Methods; 106: No. 2, 213-220(1973).
High pulse rate spark chambers require EHT power supplies capable of charging up the capacitive load of the pulser units employed in such systems. Typical values for this capacitive load are in the range 10 to 50 nF which for pulse rates of 10 per second and above results in a high current demand from the EHT supply. A compact EHT capacitor charging unit developed at the Rutherford High Energy Laboratory for use in such applications is described. (auth)

14907 CLEARING FIELD EFFECTS IN SEALED GLASS SPARK CHAMBERS. Stubbs, R. J.; Breare, J. M. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 106: No. 2, 381-387 (1973).
The efficiency of spark chambers, consisting of sealed glass boxes filled with neon-helium mixture and having external metal electrodes, has been found to depend upon the rate of pulsing of the chambers. This effect is due to internal clearing fields, produced by the discharges themselves, which influence the whole chamber and not just the area around the spark. The fields are small, of the order of 1 V/cm, and are most likely to be caused by charge movement over the glass surface from the position of the originating discharge. (auth)

14908 HIGH ENERGY NEUTRON DETECTOR USING PROPORTIONAL WIRE CHAMBERS. Atac, M. (National Accelerator Lab., Batavia, IL); Majka, R.; Dhawan, S. Nucl. Instrum. Methods; 106: No. 2, 389-392(1973).
A neutron detector using alternating layers of multiwire proportional chambers, steel plates and plastic scintillators and a proportional chamber readout system was built. The results indicate that a spatial resolution of $\sigma = 7$ mm with a 61% total detection efficiency in determining the neutron positions can be achieved. This

type of detector may also be used in identifying high energy muons. (auth)

14909 POSITION ALGORITHM FOR A HIGH ENERGY NEUTRON DETECTOR USING PROPORTIONAL WIRE CHAMBERS. Tanenbaum, W. (Yale Univ., New Haven). Nucl. Instrum. Methods; 106: No. 2, 393-395(1973).

Five pairs of multiwire proportional chambers with iron converters are used to produce and record showers of high energy neutrons. The wire spacing is 1 cm. An algorithm is constructed to predict the neutron impact point. A resolution of $\sigma = 7$ mm was achieved except for a small contamination of background. A 61% total efficiency was achieved with 15.6% background. With additional cuts, a 19% total efficiency was achieved with 4.5% background. (auth)

14910 AUTOMATION OF READOUT OF FILM INFORMATION ON SAOS INSTALLATIONS. Ovsov, Yu. V.; Noskov, Yu. G. (Inst. of High Energy Physics, Alma-Ata, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 37-40(1972).

In order to increase the rate and accuracy of measurements of films on SAOS (semiautomatic optical scanning) instruments, an attachment was designed which allows a portion of the image lying near the optical axis of the projector to be scanned and the film information to be read out automatically. A dissector is used as the scanning device. For such a method of readout it is possible to couple the measurement unit to an electronic computer operating either "on-line" or "in-line." In the first case the electronic computer performs operative monitoring of the measurements and communicates these results to the operator. In the second case, besides providing operative monitoring, the electronic computer likewise performs the functions involved in supervising the measurement process. (4 figures) (auth)

14911 BUBBLE DENSITY DETERMINATION IN BUBBLE CHAMBERS. Ganovici, I.; Nichitiu, F. An. Univ. Bucuresti, Fiz.; 19: 9-17(1870).

The gap distribution function was extended for negative gaps; and the mean length of the gaps, the lacunarity, and the gap density were calculated for two possibilities: when the blobs were not considered and when the blobs were considered. The bubbles density g is proposed to be determined from the mean value of the bubble + blob size ($\overline{D_{b+B}}$). (auth)

14912 MEASUREMENT OF MISSED COUNTS BY MEANS OF LIGHT PICKUPS. Kputsov, A. V.; Khazins, D. M. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 707-709(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 82-84(1972).

A direct method of measuring missed counts in complex recording systems containing scintillation and Cherenkov detectors is proposed. The method is based on simulating events by means of light pickups. The fraction of simulated events lost in the recording process yields the magnitude of the missed counts. A specific example of measuring missed counts by this method is described; possible systematic errors and limitations of the method are considered. auth)

14913 TIME PROPERTIES OF A SPARK CHAMBER FILLED WITH HELIUM OR A MIXTURE OF HELIUM WITH HYDROGEN. Zaimidoroga, O. A.; Ivan'shin, Yu. I.; Chernenko, L. P. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 667-669(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 48-50(1972).

The time characteristics and efficiency of a spark chamber which is filled with He or a He + H_2 mixture are determined. It is shown that in He, effective memorization of the tracks of charged particles occurs as a consequence of the transition of the atoms to metastable levels. (auth)

14914 ELECTRICAL POWER SUPPLY SYSTEM OF SPARK CHAMBERS HAVING A SMALL GAP. Parkhomchuk, V. V.; Pestov, Yu. N.; Fedotovich, G. V. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 670-672(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 50-52(1972).

An electrical power supply system for spark chambers is described which is implemented using two air spark gaps and which allows a pulse leading edge having a duration of 20 nsec to be obtained across a spark-chamber wave load of 0.4 Ω for an amplitude of 5 to 20 kV and a pulse length of 60 to 140 nsec. (auth)

14915 SIMULATION OF A SHOWER IN A SPARK CHAMBER. Sterligov, A. G.; Usov, Yu. P. (Scientific-Research Inst. of Nuclear Physics, Tomsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 673-674(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 53-54(1972).

A shower of charged particles in a narrow-gap spark chamber was simulated by ultraviolet illumination. For a power supply consisting of a low-ohm pulse generator producing pulses of fixed length, up to 200 sparks were recorded in the chamber with an efficiency close to 100%. (auth)

14916 TECHNOLOGY OF THE FABRICATION OF WIRE ELECTRODES OF SPARK CHAMBERS HAVING LARGE DIMENSIONS. Konstantinov, V. F.; Prokhorov, A. N. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 675-676(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 55-56(1972).

The technology of fabricating wire electrodes of spark chambers having an area of up to 10 m^2 is described. In the fabrication of several tens of chambers a high replicability is achieved from sample to sample. (auth)

14917 SYSTEM FOR STABILIZING THE SPECTROMETRIC CHANNEL OF A CHERENKOV COUNTER. Kramarenko, V. A.; Khachaturyan, M. N. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 658-660(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 39-42(1972).

A stabilization system of the digital-analog type for a total-absorption Cherenkov γ spectrometer with an FÉU-49 photomultiplier is described. The light flash produced by α particles from ^{241}Am in a CsI(Tl) crystal was used as the reference. A long-term stability of the results ~1% was obtained. (auth)

Radiometric Instruments

Refer also to abstracts 14989 and 14990.

14918 (EURISOTOP-13) CONTROL OF THE DEGREE OF FILLING BY RADIOISOTOPES DURING THERMAL CRACKING. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Feb. 1972. 18p. (In French). Dep. NTIS (U.S. Sales Only).

The methods of avoiding, by means of radiometric measuring methods, the contamination of cracking installations caused by an uncontrolled increase of coke sponge in the coke chambers are reported. The principal characteristic of the radiometric method is its simplicity and its continuity during the measurement. The radiometric device uses ^{60}Co as the radioactive element and a scintillation detector as the detection agent. This technique is compared technologically and economically with conventional methods. (JSR)

14919 RADIOISOTOPE X-RAY FLUORESCENCE ANALYZER FOR THE ON-LINE PROCESS CONTROL. Tanemura, T.; Suita, H. (Rigaku Denki Co., Tokyo). pp 69-80 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays, Boston, MA (10 Jun 1970). See CONF-700611.

The design, operation, and performance of a radioisotope x-ray fluorescence analyzer for on-line process control are discussed. This type of equipment has been used in the process control system in a Japanese cement plant since 1964. (LCL)

14920 PULSED LOW ENERGY X-RAY GAUGE. Cho, B. Y.; Utt, O. L.; Pfeifer, R. J. (Industrial Nucleonics, Columbus, OH). pp 105-13 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Means to improve the reliability and stability of an x-ray thickness gauge are discussed. The stability of the gauge can be improved by regulating the anode voltage and current, shaping the energy spectrum of the radiation externally, and frequently standardizing the gauge against reference samples. The latter is the most effective way, and a prototype gauge built on this principle is shown. The block diagram of the signal-processing electronics and results of preliminary tests are included. The strong sensitivity to composition limits the usage of the gauge to applications where the composition is held relatively constant. (8 figures) (RWR)

14921 DATA PROCESSING IN RADIOMETRIC APPARATUS WITH TRANSMISSION OF INFORMATION BY COMMUNICATION CHANNEL. Gorn, L. S.; Khazanov, B. I. Yadern. Priborostr.; No. 12, 33-46(1970). (In Russian).

The simplest methods of processing measurement results during their transmission by communication channels are examined in a summary fashion. The classification of these devices by their con-

struction method was given and a brief description is given of the most characteristic installations of each type. (tr-auth)

14922 USE OF X-RAY ANALYZER WITH SEMICONDUCTOR DETECTOR FOR ELEMENT ANALYSIS. Baldin, S. A.; Egiazarov, B. G.; Ioannesyants, L. M.; Sel'dyakov, Yu. P. Yadern. Priborostr.; No. 12, 85-93(1970). (In Russian).

The results of the use of the x-ray analyzer with semiconductor detector Si(Li) in the element analysis of materials were examined. Block circuits of the installation were given. The complete energy resolution of the semiconductor spectrometer was 1.0 keV. The sensitivity of the analysis, linearity, and mean square error of the measurement were determined experimentally during analysis on tin and molybdenum. The characteristics of the use of radioactive sources ^{109}Cd, ^{147}Pm, ^{153}Gd for excitation of the sample were given. Comparisons were made with other methods of analysis. (tr-auth)

14923 SIMPLE X-RAY SPECTROMETER FOR ANALYSIS OF SAMPLES BY THE FLUORESCENT X-RAY SPECTRUM. Baldin, S. A.; Kir'yanova, L. N.; Pushkarev, A. V.; Kholomov, M. D. Yadern. Priborostr.; No. 12, 94-100(1970). (In Russian).

An experimental model of a scanning small-size single-channel spectrometer using the Soller method for x-ray spectrometric analysis of liquid, solid, and powder samples was developed. The device consists of three units: spectrometer, high voltage stabilizing rectifying device, and counting-recording unit. The spectrometer is completely enclosed within a hermetically sealed casing which guarantees safe operation and makes it possible to carry out analyses of light elements by flourescent spectra in helium atmosphere. There is a lock for the introduction of samples into the spectrometer chamber without impairment of the seal. The self-cooling x-ray tube BS-1 was used as a source for the excitation of the fluorescent spectra of samples. A lithium fluoride crystal was used as analyzer and the detectors were a proportional counter and an NaI(Tl) crystal scintillator. There is a set of multiplate collimators with different resolution angles. The sensitivity for the MoK_α line is less than 0.01%. (tr-auth)

14924 OPTIMIZATION OF RADIOMETRIC APPARATUS DURING DETERMINATION OF LOW LEVELS OF RADIATION. Konstantinov, D. I.; Matveev, V. V.; Yuzvuk, Yu. A. Yadern. Priborostr.; No. 12, 15-23(1970). (In Russian).

The possibility of the use of the verification methods of statistical hypotheses for the development of working formulas permitting the determination of the sensitivity threshold of radiometric devices for the measurement of extremely small concentrations of radioactive isotopes was examined. The validity of the Poisson approximation of the probability distribution of readouts down to readouts equal to unity was shown. Working formulas for the sensitivity threshold of radiometric installation with known values of background radiation were developed. (tr-auth)

14925 TERMINOLOGY IN THE AREA OF ELECTRONIC INSTALLATION OF A RADIOMETRIC APPARATUS. Gorn, L. S.; Khazanov, B. I. Yadern. Priborostr.; No. 12, 24-32(1970). (In Russian).

Questions on the selection of terms were examined and concepts pertaining to electronic installations of radiometric apparatus were determined. A series of basic concepts connected with the parameters of signals from detectors were determined. Assumptions on the determination of the basic types of electronic measurement devices, including meters and pulse filters, were reported. Variations which were necessary to introduce in accepting current terminology were examined. (tr-auth)

14926 APPLICATION AND ADVANTAGE OF BETA-RAY GAUGE IN THE PULP AND PAPER INDUSTRY. Aoki, Hiroo (Daishowa Engineering Co. Ltd., Fuji, Japan). Genshiryoku Kogyo; 18: No. 3, 48-53(Mar 1972). (In Japanese).

The most remarkable radiation instrument used in the pulp and paper industry is the β-ray weight gage applied to paper machines. These are systems to determine both dry weight and percent moisture by processing the results of transmitted β-ray measurements and moisture measurements with moisture gages. Merits of the system are quality improvement, production increase, and cost reduction. To date, paper machine processes often have not been operated to get maximum total performance because hardware manufacturers have had little knowledge on the making of paper sheets. On the other hand, the engineers have not understood how to handle these control systems. It is desirable that the users purchase the whole system including software from the manufacturers after discussing the system through co-operative research by the users and the manufacturers. (Japan)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 15387, 16426, and 16431.

14927 (ORNL-TM-3998) GAMMA-RAY DAMAGE AND ANNEALING IN ULTRA-HIGH PURITY GERMANIUM. Blankenship, J. L. Jr. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 196p. Dep. NTIS.

Thesis.

Defects introduced by ^{60}Co gamma rays at 0°C in n-type and p-type germanium were studied using Hall coefficient and electrical conductivity measurements. The material investigated had net impurity concentrations in the range of 10^{11} to 10^{12} cm^{-3}; this allowed the detection of a lower range of radiation defect concentrations than which was previously feasible. The properties of defects stable at room temperature are particularly interesting, because semiconductor radiation detectors have been made by irradiating lightly doped n-type germanium with ^{60}Co gamma rays. The lack of consistent results has prevented the commercial application of this process. The defects introduced by ^{60}Co irradiation exhibited three acceptor energy levels and caused an apparent change in net impurity concentration. The acceptor level observed at $E_c - 0.235$ eV was produced by the gamma rays with an efficiency of 8.58×10^{-5} cm^{-1}. This acceptor level annealed out readily at 100°C. An acceptor level at $E_v + 0.195$ eV was observed in p-type material. Anneals at 30 to 60°C appeared to convert this level to a level at $E_v + 0.09$ eV and with an apparent change in net impurity concentration. The most stable electrical property of the radiation defects was the change in net impurity concentration, which was always toward more p-type. The carrier removal efficiency in n-type material was found to be 1.77×10^{-4} cm^{-1}. It appears possible to produce a stable change in net impurity concentration toward more p-type (or less n-type) without leaving an appreciable concentration of deep acceptor levels by using a sequence of ^{60}Co gamma irradiation and annealing. The temperature dependence of Hall mobility (μ_H) measured on germanium before irradiation agreed closely with theoretical mobility values limited only by lattice scattering. Reduction in μ_H produced by irradiation appeared to be correlated with the resulting carrier concentrations and not with the density of charged scattering centers. The magnitude of this mobility depression and the functional dependence on temperature was in disagreement with values calculated by assuming only binary encounters contribute to the ionized-impurity scattering rate. (auth)

14928 THERMOLUMINESCENCE OF $CaSO_4$:Mn PHOSPHOR UPON EXCITATION BY LOW- AND MIDDLE-ENERGY PROTONS. Vidyakin, G. S.; Kazachevskaya, T. V.; Novikov, L. S. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 6, 622-623(Jun 1972).

Translated from Opt. Spektrosk.; 32: No. 6, 1148-1150(Jun 1972).

Results are given for excitation of $CaSO_4$: Mn phosphor by protons with energies from 100 keV to 500 keV and from 3 MeV to 6 MeV. The basic characteristics of the phosphor are obtained; the energy yield of the latter is determined. It is concluded that the use of $CaSO_4$: Mn phosphor as a detector for recording proton fluxes is possible. (auth)

14929 DEVELOPMENT OF A NEW RADIOISOTOPE LEVEL GAUGE AND ITS APPLICATION. Nashimoto, Ryuzo; Toyama, Noboru (Hitachi Ltd., Chiba, Japan). Hitachi Hyoron; 54: No. 8, 692-694(Aug 1972). (In Japanese).

An automatic radioisotope level gauge with iridium 192 (less than 100 μC), which is intended for the non-destructive inspection of diffusion pump oil, is described. This level gauge proved, in measurement of a diffusion pump oil in exhaust carts, to be able to measure oil quantity with a small error of ±5 cc. Also, as a result of clarifying the mechanism of diffusion pump oil defects in exhaust carts by using this level gauge, the mean time between failures of exhaust carts could be made about 2.3 times longer. (auth)

14930 SOME ASPECTS OF THE INFLUENCE OF GAMMA RADIATION ON PHOTOMULTIPLIER TUBE. Zimek, Zbignev (Inst. of Nuclear Research, Warsaw). Nukleonika; 17: No. 5/6, 301-304(1972). (In Russian).

Dark currents produced by the EMI 6256B photomultiplier were measured during γ-irradiation of different parts of the photomultiplier. Selective influence was achieved by the use of a collimated gamma beam of degradated ^{60}Co radiation. The sensitivities of particular parts of the photomultiplier are dis-

cussed, and basic phenomena responsible for the effects are defined. (auth)

Miscellaneous Instruments

Refer also to abstracts 14691, 14692, 14704, 14851, 14988, 15135, 15177, 16464, 16505, and 16822.

14931 (BMBW-FB-W-72-3) EVALUATION OF A HELIUM COOLED ION SOURCE WITH SUPERSONIC WIND TUNNEL AND MODEL CALCULATION. Lippmann, H.; Tatarczyk, H. (Bundesministerium fuer Bildung und Wissenschaft, Bonn (West Germany)). Jan 1972. 58p. (In German). INIS.

The advantages and the layout of a mass spectrometer with a helium-cooled ion source for use in upper atmosphere research are described. Functional tests have been performed in a supersonic wind tunnel of the DFVLR at Porz-Wahn. They have verified the fact that the shock in front of the cooled front plate of the ion source can be eliminated for typical flow conditions of a rocket flight. Furthermore the equation of Gustafson and Kiel (1964) for the density distribution behind an orifice has been extended to a form applicable to this ion source. The spatial density distribution inside the ion source has been calculated numerically. (INIS)

14932 (CERN-72-21) PROCEEDINGS OF THE 1972 CERN COMPUTING AND DATA PROCESSING SCHOOL, PERTISAU, AUSTRIA, 10-24 SEPTEMBER 1972. (European Organization for Nuclear Research, Geneva (Switzerland)). 1 Dec 1972. 503p. Dep. NTIS (U. S. Sales Only).

Separate abstracts were prepared for five of the items in these proceedings. The remaining seven, which were not in the subject scope of NSA, were entitled Function Minimization, Function Parametrization, Small Computers in Physics, On Board Computers for Satellites, Radio Telescope Control, Significant Concepts in Data Base Management, and Theory and Practice of Compilation. (RWR)

For abstracts of individual papers see: 14850, 14851, 14933, 15455, and 15461.

14933 (CERN-72-21, pp 187-273) SYSTEM ASPECTS OF SMALL COMPUTERS IN PARTICLE PHYSICS: A PERSONAL VIEW. Zacharov, B. (CERN, Geneva). 1 Dec 1972.

The role of the small computer as one component in some total system necessary to solve a given problem is discussed. The meaning of the term "small computer" is defined, and the reasons for using such a computer rather than a certain fraction of a large computer are considered. The major part of the paper is divided into two broad areas: a general review of those areas where small computers are used in the whole field of elementary-particle physics and detailed considerations of some particular aspects, mainly interfacing of equipment and communications links. Accelerator control is not included. Applications of small computers include the following: data acquisition, buffering and packing, sampling, feedback of information, process control, multiplexing, and interfacing and terminals. CAMAC is discussed in some detail, including general philosophy, the Dataway (Dataway operations, status signals, and block transfers), multicrate systems (the branch highway, demand handling, the crate controller, the branch driver, multibranch systems, and typical transfer times), CAMAC modules, software for CAMAC, and CAMAC systems. Data links are then considered: the need for data links, systems features of data networks, practical link implementation and user terminals, terminals outside the laboratory boundaries, implementation of a digital microwave link, and performance of this link. In conclusion, it is felt to be especially helpful to have modularity in both hardware and software; in this way, previous results and subsystems can be rapidly incorporated into any new system. An equally important aspect of the modular system philosophy is that a given computational task can be distributed in such a way that each separate function can be implemented on that part of the system best suited to the needs. Distributed computing is also the best way to keep in step with the very rapidly changing situation, both in the requirements of physicists and in the availability of new computer hardware and software. In the future, attention will probably not be directed to small computers as such; they will be merely another component of a complex data processing system. (15 figures, 7 tables) (RWR)

14934 (CISE-N-156) REAL-TIME CONNECTION OF A MULTICHANNEL PULSE HEIGHT ANALYZER TO A IBM 1800 COMPUTER. Corti, M.; De Agostini, A.; Vanoncini, M.; Vendramini, A. (Centro Informazioni Studi Esperienze, Milan (Italy)). Oct 1972. 9p. Dep. NTIS (U. S. Sales Only).

A direct cable connection of a Laben 1024 channel pulse-height analyzer to an IBM 1800 computer is described. The advantages of such a connection are discussed and a short description of the interface logic is given. (auth)

14935 (LA-DC-72-1458) STANDARD SOFTWARE FOR CAMAC. Dhawan, S. (Yale Univ., New Haven, Conn.); Thomas, R. F. Jr. (Los Alamos Scientific Lab., N. Mex.). 1972. 5p. (CONF-721202-6). Dep. NTIS.

From Nuclear science symposium and exhibits: nuclear instrumentation for research and development; Miami Beach, FL (6 Dec 1972).

The NIM Committee and ESONE have formed working groups to study the problems of CAMAC software. The results which have been obtained to date are summarized. The NIM Software Working Group has endorsed six FORTRAN-compatible subroutines for CAMAC software interface, and the ESONE Software Working Group has proposed a high-level CAMAC language. (auth)

14936 (NIIAR-P-128) PRECISE AMPLITUDE GENERATOR AND THE LINEAR GATE. Ivanov, V. B.; Leshchinskii, A. G.; Shipilov, V. I. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 12p. (In Russian). INIS.

Continued stability of spectrometer characteristics are assured by autostabilizing systems. The dependability of operation in such systems depends to a large degree on the stability of the amplitude and shape of the standard signal produced by a precise amplitude generator. Such a generator was constructed, based on a transistorized chopper at constant voltage with autonomic supply and control circuits. A highly-stable linear gating circuit with this type of transistorized chopper is described. (tr-auth)

14937 (TRG-Report-2291) MEASUREMENT OF IRRADIATION INDUCED SWELLING BY A SEMI-AUTOMATIC LENGTH MEASURING TECHNIQUE. Watkin, J. S.; Ervine, R. W.; Cocks, H. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). 6 Apr 1972. 12p. Dep. NTIS (U. S. Sales Only).

Following the discovery in 1966 of void formation in Type 316 stainless steel after irradiation in DFR, it was considered necessary to determine the swelling behavior of a wide range of materials that were being considered for Fast Reactor application. Because of the large number of specimens involved in these studies and the time consuming nature of both density and void counting techniques, a semi-automatic machine capable of measuring the length of irradiated specimens 1 cm long to an accuracy of $\pm 5 \times 10^{-5}$ cm at a rate of 30 per day has been developed. The equipment and techniques being used are described. (auth)

14938 HIGH PRECISION DILATOMETER. Granata, S.; Potenza, F. pp 469-80 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The operating principles and construction details are given for a high precision dilatometer using a differential transformer for measurement of the elongation. (JSR)

14939 APPARATUS FOR THE DIFFRACTION OF COLD NEUTRONS AND POSSIBLE TECHNOLOGICAL APPLICATIONS. Walther, H.; Pizzi, P.; Vincenzi, A. B. (Sorin, Centro Ricerche Nucleari, Saluggia, Italy). pp 509-42 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

An apparatus for the diffraction of cold neutrons designed to characterize inhomogeneities such as distortions, defects, or diverse phases is described in detail. The cold source, collimator, guide tubes, and monochromator are considered. The experiments to be carried out with this device are discussed. (JSR)

14940 DATA RETRIEVAL ON THE SCREEN OF A CATHODE RAY TUBE FROM A PULSE ANALYZER WITH ASSOCIATIVE STORAGE REGIME. Agapov, S. A.; Khlyustikov, N. M. Yadern. Priborostr.; No. 12, 125-32(1970). (In Russian).

Methods for the retrieval of information on cathode-ray-tube screens with associative storage were examined. The operation of the associative analyzer in the retrieval regime when supplementary external equipment and auxiliary memory space was at a minimum was described. The retrieval program was given. (6 figures) (tr-auth)

14941 AI-4096-3 ANALYZER IN ASSOCIATIVE REGIME. Agapov, S. A.; Khlyustikov, N. M. Yadern. Priborostr.; No. 12, 133-8(1970). (In Russian).

The potentialities of the AI-4096-3 analyzer, operating in the associative regime, were examined. It was shown that the scanning of the associative address can be done on one memory cycle without use of the intermediate memory. The operation of the analyzer was illustrated by photographs of the spectra obtained. (5 figures) (tr-auth)

14942 INTERMEDIATE MEMORY BZU-22M, TIME CONVERTER BVP-6M, AND METHODS FOR THE VERIFICATION OF THEIR BASIC CHARACTERISTICS. Rekhin, E. I.; Lyaporov, V. M.; Pankratov, V. M. Yadern. Priborostr.; No. 12, 139-47(1970). (In Russian).

Block diagrams for the BVP-6M for conversion of time intervals into numerical code and the intermediate memory BZU-22M were examined. Methods for the verification of the basic characteristics of time analyzers using these circuits were proposed. (5 figures) (tr-auth)

14943 MEMORY FOR PARAMETRON CIRCUITS. Titov, L. G. Yadern. Priborostr.; No. 12, 148-60(1970). (In Russian).

A survey is given of the basic types of memory operating in combination with parametron (parametric subharmonic oscillator) circuits. The purely parametron memory of the dynamic type (three parametrons in series), matrix memory (two parametrons in series), memory with use of rectifier parametron (one parametron in series), magnetic core memory, and memory with use of ultrasonic delay line were examined. An analysis was made of the advantages and disadvantages of each of these memory types. Recommendations were made on the advisability of their use in electron physics parametron devices. (6 figures, 1 table, 20 references) (tr-auth)

14944 FORM OF THE ENERGY AND ANGULAR CHARACTERISTICS OF CYLINDRICAL ELECTROSTATIC ANALYZERS. Kovalenko, V. G.; Polenov, B. V. Yadern. Priborostr.; No. 12, 216-29(1970). (In Russian).

Results were reported on the calculation and experimental verification of the energy and angular characteristics of cylindrical electrostatic analyzers as a function of the rotation angle and beam form of the incident particle. A comparison of the results obtained was reported, and the reasons for the divergence of the experimental and calculated results were indicated. (5 figures, 1 table) (tr-auth)

14945 WIDE-RANGE RECORDERS. Ivanov, I. D.; Khazanov, B. I. Yadern. Priborostr.; No. 12, 47-68(1970). (In Russian).

A review is presented of the different methods of construction of wide-range recorders, measuring the value of the direct and modulated current, number of pulses, and mean frequencies of pulses produced by detectors. Circuits with data presented both in analog and digital form are examined. (tr-auth)

14946 WIDE-RANGE METERS FOR AVERAGE PULSE FREQUENCIES. Gorn, L. S.; Zhurina, L. S.; Khazanov, B. I. Yadern. Priborostr.; No. 12, 69-74(1970). (In Russian).

A method for the construction of a wide-range meter for average frequencies of pulse sequences was described. The meter can function both in logarithmic measurement regime and in linear regime with manual switching of the subband. (tr-auth)

14947 ABSOLUTE SYNCHRONIZATION SYSTEM FOR MOESSBAUER SPECTROSCOPY. Gangas, N. H. J. (Univ. of Ioanniana, Athens); Gaitanis, N,. Kostikas, A.; Simopoulos, A. Nucl. Instrum. Methods; 106: No. 2, 409-410(1973).

A synchronization system for Moessbauer spectroscopy is described which removes some of the disadvantages of existing systems and can be easily assembled with commercially available integrated circuit components. (auth)

14948 DECADE SCALER WITH AN IMPROVED NOISE IMMUNITY. Rybakov, V. G. (Inst. of High Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 376-378(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 68-69(1972).

A decade scaler based on transistor static triggers without memory capacitors and with potential coupling between triggers is described. The input circuits of the triggers are shunted by capacitors; this arrangement makes the scaler very immune to noise. The scaler is designed for counting long pulses having a large repetition interval, and may be used in a frame counter in experiments involving photography. (3 figures) (auth)

14949 DECADE SCALER OPERATING AT 120 MHz. Rodnov, Yu. V. (Inst. of High Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 373-375(1972).

Translated from Prob. Tekh. Eksp.; 15: No. 2, 65-67(1972).

A decade scaler having a maximum counting rate of 120 MHz is described. The scaler consists of five triggers designed using tunnel diodes and transistors, a decoder, and a digital gas discharge tube. (4 figures) (auth)

14950 ION SOURCE FOR RADIOACTIVE ELEMENTS. Piotrowski, A.; Raiko, V. I.; Tyrroff, H. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 323-326(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 23-26(1972).

An ion source of the magnetron type for the separation of radioactive isotopes is described. For a quantity of radioactive isotopes amounting to 10^{-9} to 10^{-12} g and several milligrams of stable marker substance the efficiency of separation is ~10%. The source operates at a temperature 1000°C, and allows the separation process to be carried out in several minutes. (5 figures) (auth)

14951 CHOPPER-MONOCHROMATOR FOR COLD NEUTRONS, WHICH HAS A LARGE CROSS SECTION OF THE PACKAGE SLITS. Shitikov, Yu. L.; Zemlyanov, M. G.; Naumov, I. A.; Chernoplekov, N. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 327-329(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 26-29(1972).

The construction and test results of a chopper-monochromator for a time-of-flight neutron spectrometer are described. For a rotor diameter of 30 cm, a slit-package size 4.5×11 cm, a slit width of 0.3 cm, and a speed of rotation of up to 12×10^3 rpm, the chopper-monochromator, which operates after a polycrystalline Be filter, ensures extraction of the primary spectral line of cold neutrons with a wavelength resolution $\Delta\lambda/\lambda \leq 10\%$. (3 figures) (auth)

14952 RECEIVING DEVICE OF A MASS-SEPARATOR FOR INVESTIGATING SHORT-LIVED ISOTOPES. Vasilenko, A.; Mahunka, I.; Mate, Z.; (and others) (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 336-338(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 34-36(1972).

A device is described for transporting short-lived isotopes from a mass separator to detectors. The investigated isotope is collected on a carrier tape near the focal plane and then transported in 2 to 3 sec to the detectors with an accuracy ±1 mm. The spectrum of α, β, e^-, and γ radiation is measured by means of spectrometers having surface-barrier Si$^-$, Si(Li), and Ge(Li) detectors. (2 figures) (auth)

14953 ELECTRONIC EQUIPMENT FOR MEASURING THE RATIO BETWEEN THE CROSS SECTIONS OF FAST-NEUTRON RADIATIVE CAPTURE AND FISSION. Poletaev, E. D.; Kononov, V. N.; Bokhovko, M. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 361-364(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 55-58(1972).

Electronic equipment is described which is used in an experiment in the absolute measurement of the ratio between the radiative capture and fission cross sections of ^{239}Pu and ^{235}U in the neutron energy range 10 keV to 1 MeV on a pulsed van de Graaff accelerator. The equipment allows the capture and fission events to be identified, and the neutron energy to be measured according to the time of flight. (3 figures) (auth)

14954 PULSE SHAPER WITH DIFFERENTIATION AT ITS INPUT. Meleshko, E. A. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 387-389(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 76-78(1972).

A pulse shaper for radiation detectors is described which is designed for operation under conditions of increased loading. The distinguishing feature of the shaper is the use of a differentiating unshorted line at its input, which allows separation of superimposed pulses and almost full realization of a short (~11 ns) resolving time of the shaper. Besides the principal output the shaper contains an output which produces a pulse that is stretched by a charge-storage diode for use as an inhibit pulse in anticoincidence circuits. (3 figures) (auth)

14955 GENERATOR WITH AMPLITUDE AND LENGTH STABILIZATION OF THE PULSE FOR SUPPLYING A STREAMER CHAMBER. Rudenko, N. S.; Tsvetkov, V. I. (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 409-411(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 94-96(1972).

A generator producing pulses having an amplitude of 200 kV and a length of 14 n is described. The pulse length of such a generator is stable, and is determined by the transit time of the leading edge of the wave in the shaping line. The amplitude of the pulses is stabilized by means of a three-electrode spark gap, which allows

operation on the flat portion of the charging pulse of an Arkad'ev–Marx generator. The results of tests performed on the generator showed that, within the limits of the measurement error, no scatter of the pulse amplitude or of the width of cosmic-particle tracks is observed. (3 figures) (auth)

14956 ION OPTICS OF THE DOUBLE FOCUSING MASS SPECTROMETER WITH PARALLEL BEAMS. Alexandru, Gr. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 8, 907-919(1972). (In Rumanian).

The main parameters of the double focusing mass spectrometer with parallel beams are determined. The aberrations are calculated in the approximation of inhomogeneous and with circular boundary deflecting fields. The work is presented in the terms of the transfer matrix. (auth)

14957 IMAGE INTENSIFIERS. Cole, J. L. (Dudley Road Hospital, Birmingham, Eng.). Brit. J. Radiol.; 45: No. 530, 157-158(Feb 1972).

In a very brief note, the radiation hazards are pointed out in relation to image intensifiers based on a fixed x-ray dose falling on the image phosphor of the intensifier, the dose being automatically maintained by adjustment in milliamperes to the x-ray tube, irrespective of the object placed between the x-ray source and intensifier. The current may therefore vary from 0.25 mA for the chest to the region of 6 mA for the abdomen, and on the whole, the smaller the diaphragm, the higher the milliamperes. It is pointed out that under these conditions the image intensifier/television system is not working at its ultimate sensitivity and there is an increased dose to the patient, although the signal-to-noise ratio is improved. (UK)

14958 EVALUATION OF Gd_2O_2S:Tb AS A PHOSPHOR FOR THE INPUT SCREEN OF X-RAY IMAGE INTENSIFIER. Ludwig, G. W.; Prener, J. S. (General Electric Corp., Schenectady, NY). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 4, 3-8(Aug 1972).

X-ray fluorescent screens consisting of a powder embedded in a silicone resin matrix and deposited on an aluminum plate have been prepared with the phosphors Gd_2O_2S: Tb and (ZnCd)S: Ag(P-20) at a series of different screen thicknesses. The x-ray conversion efficiency of the screens was measured using both radioisotopes and a dental radiography unit as x-ray sources. To simulate screen performance in an x-ray image intensifier tube, the screens were optically coupled to the photomultiplier which served as the detector. It was found that Gd_2O_2S: Tb screens were substantially superior to P-20 screens in both x-ray conversion efficiency and x-ray energy absorption efficiency. Experimental screen efficiencies agree with those derived from theory by an analysis in which the efficiency of the conversion of absorbed x-ray energy to light is assumed equal to the energy efficiency of the phosphor under cathode ray excitation and optical parameters of the screens are used to estimate the efficiency with which the generated light is transmitted to the detector. (auth)

14959 OVERVOLTAGE AND BREAKDOWN PATTERNS OF FAST MARX GENERATORS. Morrison, R. W.; Smith, A. M. (Carleton Univ., Ottawa). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 4, 20-31(Aug 1972).

Spark gap overvoltages of fast Marx generators in the 100 to 300 kV range were studied as a function of stray and interstage capacitance for several circuit designs. Overvoltage measurements were made at low voltages by simulating the spark with a silicon-controlled rectifier. Breakdown times were measured to nanoseconds by viewing the light flash from the sparks with a fast photomultiplier. The influence of the ultraviolet irradiation on breakdown time was studied by masking the first gap. Practical conclusions for Marx generator design are presented. (auth)

14960 STUDY OF THE EFFECT OF THE WALL TEMPERATURE OF IONIZATION GAGES ON LIMITING PRESSURE MEASUREMENTS. Choumoff, P. S.; Iapteff, B. (Societe Generale du Vide, Paris). Vide; No. 157, Suppl., 95-101(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

In view of determining the lowest ultrahigh vacuum pressure capable of being measured, two thermal models were used to establish the effect of temperature on the residual current of ionization gages. (France)

14961 ASSOCIATIVE PULSE ANALYZER IN CHANNEL-GROUPING REGIME. Agapov, S. A.; Khlyustikov, N. M. Yadern. Priborostr.; No. 12, 120-4(1970). (In Russian).

A summary of methods for the production of nonlinear scales in amplitude and time measurements is presented. An example is given of the production of nonlinear scales by use of associative pulse analyzers in the channel-grouping regime during two-dimensional amplitude analysis. Programs for the formulation of "lists" determining the rule for the grouped channels are reported. (tr-auth)

14962 ION BEAM SOURCES WITH TILTABLE FIRING ANGLE. Freeman, J. H. (to United Kingdom Atomic Energy Authority). U. S. Patent 3,705,320. 5 Dec 1972. Priority date 5 Feb 1969, Great Britain.

An ion source for an electromagnetic separator is tiltably mounted upon the ion beam passageway. Adjustment of the inclination to the passageway of the ion beam trajectory is thus provided. (Official Gazette)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

14963 RADIOISOTOPE LABORATORY TECHNIQUES. THIRD EDITION. Faires, R. A.; Parks, B. H. London; Butterworth (1973). 312p.

The subject is covered in chapters: elements of nuclear physics; properties of radiations; production of radioisotopes; introduction to health physics; the laboratory (services, safety, materials of construction); hazard control; decontamination and the disposal of waste; laboratory apparatus; introduction to electronic techniques; detection devices: integrating types; particle detectors and their use; associated equipment; errors and corrections; the statistics of counting; the choice of counting equipment; special counting techniques; liquid scintillation counting; feasibility (assessment of usefulness of radioisotope techniques); radioactive techniques in analysis; autoradiography and gamma-radiography; applications of isotopes and radiation. Appendixes present specific information on several topics: physical constants and definitions; a simple Geiger counter or ratemeter; half thickness vs energy for beta-rays; range vs energy for beta-particles; half thickness vs energy for gamma-rays; paralysis time correction tables; some useful radioisotopes. (UK)

Isotope Separation (Industrial)

Refer also to abstracts 14690 and 14962.

14964 (CEA-CONF-2112) NEW RESULTS WITH HIGH TEMPERATURE ION SOURCE OF THE GRENOBLE TWO MAGNETS ISOTOPE SEPARATOR. Boge, M.; Dousson, S.; Geroniml, R.; Bouchez, R. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). [nd]. 6p. (CONF-720948-13). Dep. NTIS (U. S. Sales Only).

From 2nd international conference on ion sources; Vienna, Austria (11 Sep 1972).

The Grenoble Electromagnetic Isotope Separator (ISERE) has operated since 1966. The ion source is adapted to work directly with chemical elements. A very high temperature can be realized (≈3000°C). To avoid the "hash" phenomena — associated with isotopic contamination — there is no magnetic field. The ion current is about 1 mA for an acceleration voltage of 50 kV. (auth)

14965 (JINR-E13-6671) HIGH EFFECTIVE METHOD FOR ACTINIDE ISOTOPE SEPARATION. Baier, G.; Herrmann, E.; Molnar, F.; Raiko, V. I.; Tyrroff, Kh. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 16p. Dep. NTIS (U. S. Sales Only).

The efficiency of a surface ionization ion source for the electromagnetic separation of some actinide elements was determined. It was found that the efficiency depends on the source temperature and separation time. The following efficiencies were obtained: for actinium – 80%, thorium – 5.2%, uranium – 9%, plutonium – 51%, curium – 72%, and californium – 37.5%. The chemical charge preparation is described. (auth)

14966 (STI-PUB-(Vol.9)) PEACEFUL USES OF ATOMIC ENERGY. Volume 9. Proceedings Series. Proceedings of the Fourth International Conference Held at Geneva, Switzerland, September 6–16, 1971. (International Atomic Energy Agency, Vienna (Austria)). Apr 1972. 544p. (In Several Languages). (CONF-710901-Vol.9). IAEA $14.00.

Thirty-four papers on developments in isotope enrichment techniques and trends in the costs of enrichment services, the Pu–U fuel cycle for thermal and fast reactors, developments in the Th fuel cycle, safeguards systems analysis and objectives, and safeguards methods and instrumentation are included in this volume. (LCL)

14967 SEPARATION OF MERCURY ISOTOPES. Bell, W. A. Jr.; Veach, A. M. (to United States Atomic Energy Commission). U. S. Patent 3,700,892. 24 Oct 1972. Filed 25 Aug 1971.

An improvement in apparatus for the electromagnetic separation of the isotopes of mercury consists of a reservoir containing elemental mercury for placement within the ion source of the apparatus wherein the reservoir is enveloped in heating coils adapted for liquid flow therein and the assemblage is further enclosed in a soft-solder-filled outer shell of good thermal conductivity. Improved isotopic separations result from the thermal stabilization provided by the liquid flow in the heating coils as it removes spurious heat from the ion source and imparts the desired heat to the mercury charge material in the reservoir. (Official Gazette)

Isotopic Power Sources

Refer also to abstracts 14644 and 15300.

14968 (DP-1318) SAVANNAH RIVER LABORATORY ^{60}Co POWER AND HEAT SOURCES. Quarterly Progress Report, July–September 1972. Angerman, C. L. (comp.) (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Nov 1972. Contract AT(07-2)-1. 18p. Dep. NTIS.

Research on applied aspects of ^{60}Co is reported. A summary of work during the report period is presented. Significant galvanic corrosion occurred on Inconel 600, nickel-plated cobalt metal, and couples between cobalt metal and superalloys during 5000-h exposure to seawater; negligible corrosion occurred on other superalloys and the ceramic cobalt compounds. None of the materials corroded significantly during exposure to bottom mud. Initial observations indicate that the brittleness of iridium previously observed in test capsules for cobalt ceramics may be due to segregation of impurities. Heating Hastelloy X and Inconel 600 for up to 20,000 h in air at 1000°C had little effect on the resistance to oxidation during subsequent heating at 1125°C, while similar heating at 1000°C reduced the resistance to oxidation of Haynes 25 and Hastelloy C at 1125°C. W-25 wt % Re alloy is a better material for encapsulating cobalt metal than tungsten. The Cobalt Test Facility is being put into a standby condition. An iridium capsule containing CoO was intact after 1000 h in argon at 1600°C, while similar capsules containing $Co_{0.5}Mg_{0.5}O$ or $CoAl_2O_4$ developed leaks in the capsule walls. The Nickel 201 being used to fabricate the core of the WANL demonstration heat source exhibited satisfactory oxidation resistance during 3000-h tests at 1000 and 1125°C. The thermoelectric generator fueled with ^{60}Co continued to operate satisfactorily with an electrical output of 45.5 watts after 19 months. (auth)

14969 (TRW(A)-11069-67) DEVELOPMENT OF A HIGH-TEMPERATURE VENTED RADIOISOTOPE CAPSULE. VOLUME 2. DEVELOPMENT AND TESTING OF NONSELECTIVE VENTING SYSTEMS. Final Summary Report. (TRW Systems Group, Redondo Beach, Calif.). Jul 1972. Contract AT(29-2)-2551. 173p. Dep. NTIS.

Work on the design, development, and long term testing of nonselective noble metal/ceramic helium venting systems for high-temperature radioisotope heat source capsules is described. Information is included on design and performance of He venting radioisotope filters, results of high temperature He permeation experiments, results of tests on vacuum stability of candidate coating-substrate systems, and results of tests concerned with stability of vent systems under reentry heating. (JRD)

14970 RADIOISOTOPE HEAT SOURCE SYSTEM. Bunker, J. F.; Poland, J. E.; Sayell, E. H.; Schmidt, G. V. (to United States Atomic Energy Commission). U. S. Patent 3,697,329. 10 Oct 1972. Filed 4 Jun 1971.

A radioisotope heat source system which comprises a plurality of radioisotopic heat source devices arranged helically or in offset levels about and within an elongated supporting member is described. The supporting member provides protection and effective heat utilization thereof. Additional protective and heat transfer layers may be provided about the heat source devices and supporting member along with means of utilizing heat produced thereby. (Official Gazette)

Radiation Sources

Refer also to abstracts 14516, 14659, 14813, and 14846.

14971 (CNEA-320) ONE YEAR OF OPERATION OF THE EZEIZA SEMIINDUSTRIAL IRRADIATION PLANT. Papadopulos, C. C.; Ambrosoni, H.; Cancio, R.; Cannistraci, C.; Catallani, A.; Costas, L.; Kusnier, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 19p. (In Spanish). Dep. NTIS (U. S. Sales Only).

This is a critical comment about the technical aspects, construction and performance of the Semi-Industrial Irradiation Plant in Ezeiza, based on the experience through the first-year work. The adjustments made on the conveyor tracks for sampling irradiation which has a self-propelled carrier are discussed in detail. The working conditions of the following devices are analyzed: irradiation cell and sources used for it; single source holders and source supporting rack; storage swimming-pool for the source; rack elevating mechanism; hydraulics circuits; ventilation and fire-

extinction systems; health physics security set up; command control panels and other auxiliary devices. (auth)

14972 (CONF-720953-1) RADIOISOTOPIC CARDIAC PACEMAKERS IMPLANTED SUCCESSFULLY. Laurens, P. (Broussais Hospital, Paris); Piwnica, A.; Reidemeister, C.; Rabago, G. [nd]. 10p. Dep. NTIS (U. S. Sales Only).

From European cardiology congress conference; Madrid, Spain (Sep 1972).

An evaluation of ^{238}Pu-powered cardiac pacemakers inserted in 100 patients following an elapsed time of almost two and one-half years showed no failure of the pacemakers. Measurements confirm a predicted 10-year performance life for the pacemakers. (CH)

14973 METHOD OF FABRICATION OF A RADIOACTIVE ENERGY SOURCE TO BE USED AT A HIGH TEMPERATURE. Rhines, F. N.; Donovan, J. A.; McDonell, W. R. (to United States Atomic Energy Commission). Danish Patent 123,552. 3 Jul 1972. Priority date 10 Dec 1968, United States. (In Danish).

The radioactive cobalt-rhenium energy source to be used at a high temperature is characterized by porous layers of pressed rhenium and radioactive cobalt sheets placed alternately in a capsule. The capsule is then heated to a temperature above the melting point of cobalt for sufficiently long periods to permit molten cobalt to penetrate selectively into the porous rhenium layers without appreciable penetration of the cobalt into the capsule. The capsule is subsequently sealed. (auth)

Design and Fabrication

Refer also to abstract 15624.

14974 (CTH-RF-22) INVESTIGATIONS ON ABSOLUTE MEASUREMENT OF NEUTRON SOURCE STRENGTH AND FLUX DENSITY. Collen, J. (Chalmers Tekniska Hogskola, Goteborg (Sweden). Institutionen for Reaktorfysik). 1972. 70p. Dep. NTIS (U. S. Sales Only).

A 99.7-mCi (Ra–Be) source is calibrated by integration of the neutron absorption rate in a large water tank with two small BF_3 proportional counters and absolute measurement of the thermal neutron flux density in one point by activation of gold foils. The foil activities are measured by the coincidence method with a special double NE 102A plastic scintillator as 4π beta detector and two 3″ × 1″ NaI(Tl) crystals as gamma detectors. The detector efficiencies for 0.01-mm gold foils are 65% (beta) and 24% (gamma-peak), and the measured values for the thermal neutron flux density and the source strength are 3140 n/cm^2-s (±0.6%) and 1.568×10^6 n/s (±1.0%), respectively. (auth)

14975 DESIGN OF A UNIFORM HIGH ENERGY GAMMA TUBE SOURCE. Bishop, G. B.; Cleaver, J. W. (Univ. of Liverpool, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 121-124(Jan 1973).

The decay of ^{20}F flowing through parallel, uniform and conical tubes was studied. The object was to design a uniform tubular source of known geometry and strength for use in benchmark experiments on the penetration of high-energy gamma through shielding materials. Design criteria for producing uniform tube sources are discussed. Large diameter uniform tube sources are found to be impractical due to flow separation problems. (auth)

14976 POTENTIAL USE OF ^{109}Cd FOR DUAL ABSORPTION MEASUREMENTS OF SOFT TISSUE. Schmonsees, W. G.; Preuss, L. E. (Edsel B. Ford Inst., Detroit). pp 281-8 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on application of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The absorption of monochromatic radiation by a material has proven to be of great utility in the analysis of the material. The extension of this technique to studies of human tissue in vivo is discussed. The use of an isotopic source to perform dual absorption measurements on soft tissue is described. The physical and biophysical problems of such an analysis have been studied and determinations made on a number of in vitro tissue samples. The 22 and 88 keV radiations of ^{109}Cd have proved to be useful for the determination of fat-lean ratios in vitro. The long half-life and the availability of two simultaneous radiations highly sensitive to soft tissue composition in a single source, as well as the low radiation dose, make this isotope particularly attractive for in vivo studies. (auth)

14977 RECENT DEVELOPMENTS IN LOW ENERGY PHOTON SOURCES. Ansell, K. H.; Hall, E. G. (Radiochemical Centre, Amersham, Eng.). pp 357-71 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Recent developments in low energy gamma sources are discussed by considering: the properties of ^{133}Ba, ^{242}Cm, ^{243}Cm, ^{244}Cm, and ^{155}Eu as sources with particular photon emission energy levels; methods for fabricating radiation sources, particularly the fabrication of ^{241}Am sources; the advantages of Be as an encapsulating material; and the fabrication of sources with unusual geometries. (LCL)

14978 DESIGN AND USE OF LOW-ENERGY GAMMA AND X-RAY SOURCES. Pressly, R. S. (Oak Ridge National Lab., TN). pp 373-97 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

The design of low-energy gamma and x-ray sources, the efficiency for x-ray and bremsstrahlung production of a ^{85}Kr radiation source with a thin foil of U as the target, and source designs for particular uses are discussed. Specific uses of low-level sources are described and include medical radiography, whole body scanning, x-ray fluorescence analysis, determination of Ca in ground meat, and determination of As in soils. (LCL)

14979 ^{137}Cs IRRADIATION UNIT FOR SMALL-ANIMAL TESTS. Reiki, Ichiro (National Inst. of Radiological Sciences, Chiba, Japan); Soga, Kengo; Yoshikawa, Motoyuki; Kaneko, Takeo; Tsuru, Toshio. Toshiba Rebyu; 27: No. 9, 856-859(Sep 1972). (In Japanese).

A ^{137}Cs irradiation unit was constructed at the National Institute of Radiological Science in response to a demand for specific pathogen-free animal irradiation equipment. The necessary conditions for radiobiological investigation on specific pathogen-free animals in an unshielded laboratory room were a stable radiation output with an exposure rate of 90 R/min and simple operation of the unit. The ^{137}Cs unit (5,000 Ci) was chosen to meet the conditions; it has a long half life (30 years) and simple structure. The exposure was 104 ± 2 R/min throughout the inside of the cage; the leakage radiation, 0.07 mR/h at a distance of one meter from the surface of the unit. (auth)

14980 PROCESS FOR THE PREPARATION OF A ^{90}Sr–^{90}Y BETA SOURCE IN A RADIATION HAZARD FREE MANNER. Haskins, A. W. (to Nuclear Associates, Inc.). U. S. Patent 3,706,689. 19 Dec 1972. Filed 3 May 1968.

A process is described for the preparation of a ^{90}Sr–^{90}Y beta source in a substantially radiation hazard free manner comprising, in combination, the steps of providing a radioactive material containing ^{90}Sr; separating at least part of the ^{90}Sr from the radioactive material to provide a ^{90}Sr rich material which emits only low energy beta rays; fabricating a source from the low energy beta ray emitting ^{90}Sr rich material; storing the fabricated source for a period sufficient to permit the ^{90}Sr therein to become an equilibrium mixture of ^{90}Sr–^{90}Y; and utilizing the resulting stored fabricated source as a ^{90}Sr–^{90}Y beta source. This process is useful in fabricating ^{90}Sr–^{90}Y beta sources with a minimum of shielding. Such beta sources are in turn useful in medical applications of radioactivity such as radioactive eye applicators and nasopharyngeal applicators. (Official Gazette)

Industrial Uses

Refer also to abstracts 14634 and 15012.

14981 (CONF-711121–3) NEW INTERNATIONAL FOOD IRRADIATION PROJECT. Diehl, J. F. (Bundesforschungsanstalt Fuer Lebensmittelfrischhaltung, Karlsruhe (West Germany)). 1971. 6p. Dep. NTIS (U.S. Sales Only).

From 10th Japan Conference on Radioisotopes; Tokyo, Japan (16 Nov 1971).

An international agreement was signed in 1970 by 19 countries for the purpose of international collaboration in food irradiation research. The International Food Irradiation Project, which will avoid duplication of efforts by the member nations, is described and includes the following activities: wholesomeness testing of irradiated foods; research on methods for wholesomeness testing; dissemination of information on wholesomeness testing; and assisting national and international authorities in consideration of the acceptance of irradiated foods. The organization and financing of the project and research projects in progress are discussed. (LCL)

14982 (KFK-1569) WEAR BEHAVIOUR AND LOAD CAPACITY OF JOURNAL BEARINGS IN THE TRANSITION RANGE FROM FULL TO BOUNDARY LUBRICATION. (INVESTIGATIONS BY MEANS OF RADIOISOTOPES). Katzenmeier, Gustav (Kernforschungszentrum, Karlsruhe (West Germany). Laboratorium fuer Isotopentechnik). Feb 1972. 134p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ. (West Germany).

The calculation of hydrodynamically lubricated journal bearings becomes uncertain as the shaft and the bush approach the zone of mixed friction. To obtain a precise knowledge of the limit of load capacity, experiments must be performed. Wear measurement with the help of radioisotopes is a very sensitive means of assessing the limits of safe operation free from wear. Preliminary investigations using gamma-spectrometry revealed that all bearing materials containing lead—this applies to most of the commercially available bearings—can be activated by deuteron bombardment in such a manner that the bearings can be subjected to single- and multi-component wear measurements by existing measuring techniques. In a test bench set up for this purpose bearing tests were carried out under static and dynamic loads (sinusoidal cycling). The experiments provided information about the general wear and running-in behavior of bearings. The investigations concentrated on the influence exerted by the material pair shaft/bush and, above all, the surface roughness of bearing elements on the abrasion and the load capacity. The operating point characterized by the beginning of wear was defined as the limit of load capacity. In addition to the experimental points of transition into the wear regime theoretical values were calculated for the minimum thickness of the lubrication gap and related to the surface characteristics of the shaft and the bush. Based on these results, criteria were derived for the permissible load and the minimum permissible size of the lubrication gap of the bearing. Information was found which may serve as an indication of the proper running-in and safe operation of a bearing. (auth)

14983 (SGAE-2044) MOISTURE GAUGING OF SINTER ORES ON CONVEYOR BELTS: OPERATING EXPERIENCE WITH A SYSTEM FOR CONTINUOUS, NONCONTACTING MEASUREMENT INDEPENDENT OF MATERIAL MIXTURE AND ITS LAYER THICKNESS. Frevert, E.; Stehno, G. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf. Institut fuer Isotopenanwendung). Sep 1972. 15p. (CONF-720704-2). Dep. NTIS (U. S. Sales Only).

From Symposium on the use of nuclear techniques in the basic metal industries; Helsinki, Finland (21 Jul 1972).

A method to measure the moisture content of sintered materials on conveyor belts was developed in laboratory tests. Special features are continuous non-contacting measurement, the results being independent of the height of layer and the mixture of material on the belt. Primarily the moisture measurement is based on the well known method of slowing down fast neutrons. Underneath the belt there are one 1 Ci Am–Be neutron source and four 0.1 mCi Cs-137 gamma sources mounted in a container for shielding and transport. Above the belt the measuring probe is installed which measures both the thermal neutrons and the gamma radiation. The gamma- and neutron-values are electronically combined by a semiempirical law. The accuracy of measurement is better than ±0.5% by weight of moisture. The moisture gauge is in use in a steel mill since the end of 1971. Experiences gathered in that period are reported. (auth)

14984 (STI-PUB-(Vol.12)) PEACEFUL USES OF ATOMIC ENERGY. Volume 12. Proceedings series. Proceedings of the Fourth International Conference Held at Geneva, Switzerland, September 6–16, 1971. (International Atomic Energy Agency, Vienna (Austria)). May 1972. 540p. (In Several Languages). (CONF-710901-Vol.12). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sep 1971).

Seventeen papers on nuclear methods for increasing food production, 12 papers on nuclear methods for reducing food losses, and 8 papers on the education and training of scientists and technicians in nuclear technology are included in this volume. (LCL)

14985 (STI-PUB-300(Vol.14)) PEACEFUL USES OF ATOMIC ENERGY. Volume 14. Proceedings Series. Proceedings of the Fourth International Conference Held at Geneva, Switzerland, September 6–16, 1971. (International Atomic Energy Agency, Vienna (Austria)). July 1972. 528p. (In Several Languages). (CONF-710901-Vol.14). IAEA $14.00.

From 4th International Conference on the Peaceful Uses of Atomic Energy; Geneva, Switzerland (6 Sep 1971).

Thirty-six papers in several languages on uses of nuclear techniques in industry and in the investigation and development of natural resources are included in this volume. Information is included on: industrial uses of radioisotopes in various countries; irradiation techniques; nuclear methods in geology and mining; production of radioisotopes; radioisotope x-ray techniques for quality control; radiopolymerization of wood products and concretes; and tracer uses of radioisotopes in hydrology, sedimentology, oceanography, and for environmental pollution studies. (LCL)

14986 RADIOIZOTOPNYI KONTROL' I AVTOMATIKA V CHERNOI METALLURGII. (Radioisotopic Control and Automation in Ferrous Metallurgy). Smolyak, V. A.; Vasilenko, V. I. Moscow; Atomizdat (1972). 120p.

Radioisotope measurement, control, and regulating devices are discussed as applied to ferrous metallurgy. Procedures are recommended for: control of the chemical composition of a metallurgical charge, control of a sieve analysis of a batch of material, automatic control of moisture in coke, and continuous automatic control of the loss of blast furnace dust from a blast furnace. Rapid neutron activation analysis and control of wire diameter and sheet thickness are described as based on radiometry. 175 references. (KSW)

14987 PROGRESS IN INDUSTRIAL APPLICATION OF LOW ENERGY RADIOISOTOPE X-RAY TECHNIQUES. Rhodes, J. R. (Columbia Scientific Research Inst., Austin, TX). pp 3-18 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Radioisotope low-energy x-ray fluorescence, absorption, and backscatter are used mainly for coating thickness measurements and for elemental analysis. The two most significant areas of industrial application developed in the past three years are reviewed and include the use of radioisotope x-ray fluorescence analyzers and on-stream process analyzers. Data is included on the source requirements and performance of x-ray fluorescence analyzers used to determine concentrations of specific elements in various materials, such as concretes, rocks, ores, alloys. It is concluded that portable analyzers using balanced filters and scintillation of proportional detectors have an established and developing market. The basic technique is fully developed but the range of applications is by no means fully explored, nor exploited. Although the first prototype on-stream radioisotope x-ray analyzer was installed some eight years ago in a mineral processing plant, this type of equipment has found very few commercial applications as yet, and none at all in the USA. This is difficult to understand in view of the obvious advantage of compactness, low capital outlay and suitability for difficult industrial environments. Two possible reasons are the relatively high development costs of rugged equipment and the conservatism of certain branches of industry that could be the main beneficiaries of such equipment. (LCL)

14988 APPLICATIONS OF A TECHNIQUE FOR RAPID ALLOY SORTING WITH A RADIOISOTOPE EXCITED X-RAY ANALYZER. Sellers, B.; Brinkerhoff, J. M.; Hanser, F. A. (Panametrics, Waltham, MA). pp 19-32 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Radioisotope-excited x-ray analyzers (REXA) have been developed which use the measurement of the x-ray emission associated with particular elements to sort and identify alloys containing those elements. The equipment and method are described, and results for identifying and sorting aluminum, copper, and titanium alloys are presented. It is concluded that this signature comparison technique is useful for a wide range of sorting applications. The measurement time for each identifying element is normally less than two minutes. The equipment is portable, relatively inexpensive, lightweight, and simple to operate. (LCL)

14989 PORTABLE, LABORATORY, AND ON-LINE MEASUREMENTS OF COATING THICKNESS USING RADIOISOTOPE X-RAY FLUORESCENCE TECHNIQUES. Cameron, J. F. (Nuclear Enterprises, Reading, Eng.). pp 49-67 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

X-ray fluorescence methods using sealed radioisotope exciting sources are advantageous for both laboratory and on-line measurements of coating thickness because the method is rapid, nondestructive, and versatile, and the equipment is compact, maintenance-free, inexpensive, safe, and reliable. Details on choice of source and detector, range of thicknesses measurable, and some on-line applications, e.g., for thickness of electroplated

tin and zinc coatings on steel, of these thickness gauges are discussed. (LCL)

14990 ON-LINE CONTINUOUS CHECK FOR WELDED TUBULAR PRODUCTS. Foley, A. D.; Masterson, J. P.; Rice, N. M. (Wallingford Steel, Wallingford, CT). pp 81-9 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Radioisotope-excited x-ray spectroscopy equipment was developed which, by measuring the Mo content characteristics of Types 304 and 316 stainless steel, could be used on-line to identify welded tubular products made of either of these two stainless steels. The design, operation, and performance of the equipment is described. Continuous radioisotope-excited x-ray spectroscopy was installed on a production line and proved to be a valuable tool for preventing mixed grades of tubular products from being shipped to customers. The system is extremely reliable, simple to operate, and nondestructive. (LCL)

14991 INDUSTRIAL APPLICATIONS OF LOW ENERGY GAMMA EMITTING ISOTOPES. Chen, Y. M.; Cahill, B. B. (Ohmart Corp., Cincinnati). pp 91-104 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Two primary gaging techniques, involving low-energy gamma-emitting isotopes, which have been successfully used for continuous, on-line process control are preferential absorption and fluorescence excitation. These techniques have been applied in the paper industry for measuring zinc oxide and titanium oxide; in the computer industry for measuring ferric oxide on film, and ferric oxide on aluminum disc packs; in the plastic industry for measuring saran coating on thin film; and broadly in the metals industry for measuring coatings of aluminum on steel, zinc on steel, tin on steel, and many others. The basic elements of the fluorescence gage and preferential absorption gage are described. The problems of adapting these heretofore laboratory techniques to industrial environments are enumerated. Performance data achieved from successful installations is summarized. (auth)

14992 DEHYDRO-IRRADIATION PROCESS FOR WHITE POMFRET (STROMATEUS CINEREUS): SYNERGISTIC EFFECTS OF BLANCHING WITH PRESERVATIVES, PARTIAL DEHYDRATION, AND LOW DOSE IRRADIATION. Agarwal, S. R.; Kumta, U. S.; Sreenivasan, A. (Bhabha Atomic Research Centre, Bombay). J. Food Sci.; 37: No. 6, 837-40(1972).

Fish fillets were cooked in boiling water for 5 min and propyl-paraben of p-hydroxybenzoic acid was added as a preservative. The fillets were dehydrated to a moisture content of 35 to 40% and one lot of packaged samples was treated with gamma radiation at 0.5 Mrad. Tables are presented to show effects of dehydration, chemical preservatives, and irradiation on organoleptic properties and shelf life of the fish. A discussion is presented of the usefulness of various combinations of treatments. It was concluded that the appropriate combination treatment suitable for dehydro-irradiation of pomfret was sodium chloride, propyl paraben and irradiation that prolonged shelf life for more than four months at ambient temperature. (HLW)

14993 RADIATION SYNTHESIZED NYLON COPOLYMER AS CARPET MATERIAL. DasGupta, S. (Atomic Energy of Canada Ltd., Ottawa). Can. Text. J.; 89: No. 4, 137-42(Apr 1972). (AECL-4038).

Commercially feasible procedures for the radiation synthesis of carpet materials with desirable properties were developed at the Commercial Products Division of Atomic Energy of Canada Limited. The optimum conditions for grafting vinyl monomers to nylon yarn and carpet material to enhance characteristics of commercial value were determined. The grafted materials were found to be superior to the starting materials in lustre, bulkiness, softness and compressibility, and abrasion resistance. (Canada)

LIFE SCIENCES

Radiation Effects on Biochemicals

14994 (CEA-R-4390) STUDY OF THE PHOTOCHEMICAL ISOMERIZATION OF ERGOSTEROL. Mermet-Bouvier, Rene (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1972. 145p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Rennes Univ. (France).

The photochemical reaction scheme of Ergosterol-Vitamin D_2 was studied. The schemes proposed in published literature are described together with earlier methods used for the analysis and determination. The method used is then discussed. In the first part, the factors concerning the changes occurring in molecular systems exposed to radiation, and the formalism used, are examined. Investigations of linear molecular systems and their applications to the reaction scheme of Ergosterol-Vitamin D_2 are discussed. The properties that enable the last three reaction schemes proposed in the literature to be distinguished are described. In the second part, the experimental analytical methods and the determinations made of the different isomers formed are presented. Chromatographic techniques (thin films, columns, gaseous phase) suitable for separating the various isomeric species are used. The existence of eight isomers was established as well as a transformation occurring in one of them. The ultraviolet and infrared spectra were obtained. A reaction scheme is proposed (in which all the quantum yield values are given) from comparisons between the calculated and experimental values of the eigenvalue of the absolute minimum value λ_m and the eigenvector corresponding to Vm. (auth)

14995 (TID-26226) RADIATION AND BIOPHYSICAL STUDIES ON CELLS AND VIRUSES. Report of Activities October 16, 1969-October 15, 1972. Ehman, U. K. (Anderson (M. D.) Hospital and Tumor Inst., Houston, Tex.). 1972. Contract AT(40-1)-2832. 18p. Dep. NTIS.

Studies on chromosome organization included development of new techniques using the ultracentrifuge and the electron microscope for determining the arrangement of DNA molecules in chromosome strands. Studies on nucleoprotein organization included the development of an automated spectrophotometer for determining denaturation profiles of five major histone fractions and of chromatin. Studies on particle beam irradiation of sensitive sites included electron beam irradiation of selected depths of single cells and irradiation of DNA using ^{241}Am alpha particles. Gamma-ray and neutron studies of cellular and nucleoprotein damage included irradiation of nucleoprotein model systems, gamma-ray induced double-strand breaks in cells and cellular repair of this damage, and x-ray microprobe analysis of intracellular ion distributions following gamma irradiation. (HLW)

14996 RADIATION EFFECTS ON SUBCELLULAR SYSTEMS AND MODEL COMPOUNDS. IV. Eighth Annual Meeting of the European Society for Radiation Biology, Basko Polje, Yugoslavia, September 20-23, 1971. Stud. Biophys.; 29: 1-202(1971). (In several languages). (CONF-710975).

Separate abstracts were prepared for the 20 full papers appearing in these proceedings. Summaries of 60 other papers presented at the meeting are included. Topics included in summary form are: synthesis, structure, and function of nucleic acids and proteins; repair and mutagenesis; and recovery and protection. (ERB)

For abstracts of individual papers see: 14583, 14997-15002, 15007-15009, 15013-15016, 15055-15057, 15087, 15102, and 15108.

14997 RADIATION EFFECTS ON ENZYME ACTIVITY. Kuzin, A. M. (Inst. of Biophysics, Puschino, USSR). Stud. Biophys.; 29: 1-10(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The different pathways of radioinduced changes in enzyme activity and the high radiosensitivity of these processes are discussed. Some mechanisms of enzyme activation and inhibition are presented. (ERB)

14998 ENERGY TRANSFER IN 5-BU-SUBSTITUTED TRANSFORMING DNA OF BACILLUS SUBTILIS AFTER IRRADIATION WITH ULTRAVIOLET LIGHT. Koehnlein, W.; Moenkehaus, F. (Univ., Muenster, Ger.). Stud. Biophys.; 29: 13-21(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The additional damage suffered by hybrid DNA after uv irradiation was investigated by physicochemical methods. The experimental evidence indicates that an intramolecular energy transfer might be responsible for the observed degradation. (auth)

14999 SOME CONSIDERATIONS ON A NEW PHOTOPRODUCT FOUND IN UV-IRRADIATED SOLUTIONS OF T2 PHAGE DNA. Cremonese, M. (Laboratori di Fisica, Rome); Gozzi, D.; Matzeu, M.; Onori, G. Stud. Biophys.; 29: 37-44(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The optical density variations after irradiation in monochromatic light are reported. At $\lambda = 2700$ Å there is a decrease in optical density due to thymine disappearance, while in the $\lambda > 3000$ Å region an increase in optical density shows the formation of a photoproduct different from the thymine dimers. The optical properties of this new photoproduct were determined, and an absorption maximum at 3250 Å was found. The kinetics of its formation under irradiation with $\lambda = 2450 \pm 30$ Å light was followed as well as its disappearance after reirradiation at $\lambda = 3250 \pm 30$ Å. (auth)

15000 FORMATION OF INTER-STRAND CROSS-LINKINGS IN THE PHOTOREACTIONS BETWEEN FUROCOUMARINS AND DNA. Dall'Acqua, F.; Marciani, S.; Ciavatta, L.; Rodighiero, G. (Univ., Padua). Stud. Biophys.; 29: 63-70(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The formation of inter-strand cross-linkings in native DNA by various furocoumarins under irradiation at 365 nm was investigated. The relationship between the photoreactivity of these substances with DNA and their skin-photosensitizing activity is also discussed. (auth)

15001 INTRAMOLECULAR ENERGY TRANSFER IN 5-BROMOURACIL SUBSTITUTED DNA OF THE DEFECTIVE PHAGE PBSH AFTER LONG-WAVE UV-IRRADIATION. Moenkehaus, F.; Koehnlein, W. (Univ., Muenster, Ger.). Stud. Biophys.; 29: 85-93(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

Experimental evidence for intramolecular energy transfer in hybrid bacteriophage-DNA is demonstrated. A quantitative estimation of the intramolecular energy transfer is given. (auth)

15002 CHROMATIN DNA LIGASE AND ITS PARTICIPATION IN REPAIR OF DNA. Kuzin, A. M.; Gaziev, A. I. (Inst. of Biophysics, Puschino, USSR). Stud. Biophys.; 29: 125-30(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The role of chromatin DNA ligase in the repair of single-strand breaks in DNA induced by ionizing radiation is discussed. (ERB)

15003 CARBONATE CRYSTALS AND SCRELOPROTEINS OF PEARL OYSTER'S SHELLS AND THE MECHANISM OF SHELL-FORMATION. Hatano, H. (Kyoto Univ.). Chishitsugaku Zasshi; 77: No. 9, 597-605(Sep 1971). (In Japanese).

Shells of the pearl oyster, Pinctada martensii, consist of about 95% calcium carbonate and a small percent of screloprotein called conchiolin. X-ray diffraction analysis revealed that calcium carbonate crystals in the nacreous layer of the shells and pearls were in the aragonite form, and those in prismatic layer were in the calcite form. Gamma-ray sensitivity of amino acids in the conchiolin, especially heterocyclic basic amino acids and mono sulfamino acids, was a little higher than that of free amino acids and amino acids constituting protein. The color of the pearl of the water mussel, Hyriopsis schlegelii, was significantly changeable by ^{60}Co γ-irradiation compared with that of the pearl oyster. The mechanism of shell formation in the pearl oysters was studied by breeding the oysters in sea water containing radioactive ^{45}Ca. The rate of uptake of the ^{45}Ca from radioactive media, the rate of turnover through tissues and organs, and the rate of deposition of the radioactivity on the surfaces of the shells and the pearls were determined. The protein component was characterized by an acidic property at an isoelectric point, pH 3.8, and several intermediate acidic proteins were found in the mucous substance. Based on these experimental results, a mechanism of shell formation of the pearl oyster was proposed, and its significance in biomineralogy and palaeontology was discussed. (auth)

15004 HISTONE F1 PHOSPHORUS CONTENT IN X-IRRADIATED MURINE LEUKAEMIC LYMPHOBLASTS L5178Y. Szumiel, I.; Rosiek, O.; Beer, J. Z.; Sablinski, J.; Kopec, M. (Inst. of Nuclear Research, Warsaw). Nukleonika; 17: No. 5-6, 321-9(1972). (In Polish).

Murine leukemic lymphoblasts of the strains L5178Y-R and L5178Y-S were irradiated with doses of 50 to 1000 rads of x rays, in vivo (strain R) and in vitro (strain S). The determinations of histone F1 phosphorus content of these cells were carried in the 4-hr post-irradiation period. It was found that the decrease of histone F1 phosphorus content is both dose and time dependent. For example, a 40% decrease of the phosphorus content was observed at 1 to 2 hr after irradiation with 600 rads. Subsequent gradual return to a value close to the control (at 4 hr) was then observed. After irradiation with a dose of 400 rads a significant inhibition was observed of the amino acid precursors incorporation into histone F1 and remaining histone fractions. At the same time inhibition of the amino acid precursors into cytoplasmic protein fractions was much less marked. (auth)

15005 DIFFERENTIAL EFFECT OF BACILLUS SUBTILIS EXTRACTS ON TRANSFORMATION WITH NON-IRRADIATED AND UV-IRRADIATED DNA'S. Filippov, V. D.; Danilevskaya, D. N. (Inst. of General Genetics, Moscow). Genetika; 8: No. 10, 149-151(Oct 1972). (In Russian).

Extracts from wild type and mutant (urv^- and rec^-) Bacillus subtilis cells, being added to the transformation medium, exert a double effect: they inactivate the transforming DNA and stimulate transformation. Diluted extract, which displays only little effect on the efficiency of transformation with non-irradiated DNA, distinctly decreases the transformation with uv-irradiated DNA. Some facts suggest that stimulation of transformation by extracted protein is non-specific and is the same for both DNA's; that is, the differential effect of extracts on transformation is due to the selective inhibition of transformation with irradiated DNA. The B. subtilis extracts are thought to contain some specific protein which binds with irradiated DNA affecting reversibly its transforming activity. (auth)

15006 FORMATION OF DENATURED DNA AFTER X-IRRADIATION OF DOUBLE-HELICAL DNA SOLUTIONS. Lukasova, Emilie; Palecek, E. (Inst. of Biophysics, Brno). Folia Biol. (Prague); 18: No. 5, 307-316(1972).

Double-helical DNA solutions were irradiated with x-rays and the formation of denatured DNA was analyzed. It was found that the minimum radiation dose required for the formation of detectable amount of denatured DNA was the lower, the greater the preceding enzymatic digestion of DNA by DN-ase I. The denatured DNA formed after irradiation, or after heating the irradiated sample to sub-melting temperature, was separated by chromatography on hydroxyapatite and its sedimentation characteristics determined in sucrose density gradient. While a low-dose exposure (0.64 eV/P) led to the production of denatured DNA molecules containing about 20 nucleotides, subsequent heating of the irradiated sample, or a higher radiation dose (5.4 eV/P) resulted in the appearance of denatured DNA fraction with considerably larger molecules. The possible relation between the formation of these fractions and radiation damage to bases was discussed. (auth)

Radiation Effects on Cells

Refer also to abstract 15059.

15007 INTRACELLULAR LOCALIZATION OF ^{3}H-URIDINE AND INCORPORATION INTO THE VARIOUS RNA FRACTIONS IN CHICKEN FIBROBLAST CELLS IRRADIATED WITH ^{60}Co-γ RAYS. Varga, L.; Varteresz, V.; Koeteles, G. J.; Mate, L. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Stud. Biophys.; 29: 29-36(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The localization and distribution of incorporated ^{3}H-uridine following pulse-chase labeling for various periods are different in the control and the ^{60}Co γ-irradiated (1100 rads) chicken fibroblast cells. The specific radioactivity values of labeled RNA fractions were considerably lower in irradiated cells. Because of the presence of a high grain number due to incorporation of ^{3}H-uridine over the cytoplasm of irradiated cells, studies on the altered transport mechanisms of precursors and/or membrane function are in progress. Preliminary results demonstrated a common occurrence of newly synthesized polysaccharides and incorporated ^{3}H-uridine radioactivity in various fractions isolated by biochemical methods. (auth)

15008 INDUCTION AND REJOINING OF SINGLE-STRAND BREAKS IN THE DNA OF UV-IRRADIATED MAMMALIAN CELLS. Kostic, L. J.; Djordjevic, O. (Boris Kidric Inst. of Nucleare Sciences, Belgrade). Stud. Biophys.; 29: 111-15(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The rejoining process of uv-induced single-strand breaks in DNA of cultured mammalian L cells was studied by alkaline sucrose gradient technique. The results show that the production of single-strand breaks that occurs immediately after uv irradiation is dose dependent. Rejoining of breaks, which is considered to be a part of the repair mechanism after x and uv irradiation appears to be performed in L cells during the first hour of post-irradiation incubation. (auth)

15009 REPAIR OF SINGLE-STRAND BREAKS IN THE DNA OF CYSTEAMINE TREATED CHINESE HAMSTER CELLS AFTER IRRADIATION UNDER OXIC AND ANOXIC CONDITIONS. Modig, H. G.; Edgren, M. R. (Karolinska Institutet, Stockholm). Stud. Biophys.; 29: 117-24(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The rejoining of single-strand breaks in the DNA from Chinese hamster cells was investigated by alkaline sucrose gradient centrifugation after irradiation under oxic or anoxic conditions with or without cysteamine. Repair of radiation-induced breaks was found to occur after both oxic and anoxic irradiation though its extent was smaller in the latter case. Cysteamine protected against damage to DNA after irradiation in oxygen but not after irradiation in anoxia. Cysteamine did not influence the extent of repair, when either oxic or anoxic irradiation conditions prevailed. The data suggests that cysteamine protects against induction of single-strand breaks probably by the removal of oxygen. No certain association between recovery from sublethal damage and rejoining of single-strand breaks in the DNA was found. (auth)

15010 CHROMOSOME ABERRATIONS INDUCED IN VITRO BY RADIATIONS OF LOW LET IN HUMAN BLOOD CELLS. Feremans, Willy (Centre P. Cogianux, Brussels). J. Belge Radiol.; 55: No. 5, 567-584(1972). (In French).

35-MeV electrons emitted by a betatron produce in human blood cells, irradiated in vitro, chromosome and chromatid aberrations; the dose-effect relation is linear for one-hit lesions; two-hit lesions are produced according to a function proportional to D^x with $X \approx 2$. The dose-rate of the 35-MeV electrons is an important factor in the production of two-hit lesions; a maximum of efficiency was observed with 100 rads/minute. One-hit lesions are not related to the dose-rate. Implications in radiotherapy must be considered. No biological difference of action was noted between RX 200 keV, γ of ^{60}Co and 35-MeV electrons in the production of one-hit and two-hit aberrations. Electrons and photons emitted by the betatron have an identical biological efficiency; technical considerations justify only the use of the one or the other type of radiation. Polyploidies and endoreduplications were more frequent in irradiated cultures; but other factors, especially the age of the culture, are equally important. The target theory is compatible with our results. The technic used in this work could be applied advantageously in the research of optimal conditions of irradiation in radiotherapy. Combinations of radio- and chemotherapy, more and more recommended in the treatment of cancer, would be based on experimental cytogenetics. (auth)

15011 RADIOSENSITIVITY OF MELANOMA CELLS IN CULTURE. Hornsey, S. (Hammersmith Hospital, London). Brit. J. Radiol.; 45: No. 530, 158(Feb 1972).

Brief comment is made on previous cell survival data of melanoma cells, (Dewey, D. L., Br. J. Radiol., 44, 816-817 (1971)). It is suggested from a brief review of the literature, that extrapolating from in vitro studies of survival curves and fractionation schemes may give a considerable underestimate of radiation doses necessary to sterilize a tumor. Except in the case of haemopoietic tissues, the shoulders of the cell survival curves of all normal tissues when these are irradiated and measured in vivo are much larger than the shoulders generally found in tissue culture. (UK)

Radiation Effects on Microorganisms

Refer also to abstracts 14998, 14999, 15001, 15017, and 15059.

15012 (AERE-R-6591) RECOVERY OF GAMMA-IRRADIATED SALMONELLAE FROM HORSEMEAT USING LIQUID CULTURE MEDIA. Kennedy, T. S.; Winsley, B. E. (Atomic Energy Research Establishment, Harwell (England)). Aug 1972. 18p. Dep. NTIS (U.S. Sales Only). UK 50 pence.

The influence of competing microflora on the recovery of S. typhimurium 14 from horsemeat that had received 0.65 Mrad of gamma radiation was examined using liquid and solid culture media. Lactose broth and selenite F broth were shown to be

unsatisfactory when used in determining Most Probable Numbers (MPN) of irradiated salmonellae. The enrichment media selenite F and tetrathionate broth were less sensitive in the recovery of irradiated salmonellae than with untreated cells. The presence of radiation-inactivated salmonellae did not influence the growth of unirradiated S. typhimurium or similar cells surviving 0.65 Mrad irradiation. (auth)

15013 RADIATION EFFECTS ON TRANSCRIPTION AND TRANSLATION IN ACETABULARIA MEDITERRANEA. Bonotto, S.; Lurquin, P.; Kirchmann, R. (CEN/SCK, Mol, Belg.). Stud. Biophys.; 29: 23-8(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

Gamma radiation very strongly diminishes the incorporation of ^{3}H-5-uridine into RNA, in whole as well as in anucleate cells or in nucleate regenerating fragments (although to a lower extent). Protein synthesis, on the contrary, is less affected by the radiation. However, in the absence of the nucleus, the translational process becomes more sensitive to the radiation as a function of time after anucleation. The hypothesis that in Acetabularia, protein synthesis can continue after the irradiation because of the presence in the cell of pre-existing molecules of messenger RNA's is supported. The fact that rifampicin, a powerful inhibitor of RNA-polymerase, was shown to affect much more RNA synthesis than protein synthesis seems to carry further evidence in the favor of this hypothesis. (auth)

15014 PHOTOSENSITIZING LETHAL AND MUTAGENIC ACTION ON 8-METHOXYPSORALEN AND NEAR ULTRAVIOLET LIGHT IN ESCHERICHIA COLI. Igali, S.; Gazso, L. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Stud. Biophys.; 29: 45-52(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

Strains possessing repair capacity were more sensitive to lethal and mutagenic photosensitization in their logarithmic growth phase while bacteria lacking repair capacity proved to be more sensitive in their stationary growth phase. (auth)

15015 STUDIES ON THE REACTIVATION OF BACTERIA PHOTODAMAGED BY FUROCOUMARINS. Chandra, P. (Univ., Frankfurt am Main); Rodighiero, G.; Dall'Acqua, F.; (and others). Stud. Biophys.; 29: 53-61(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

In photoreaction with the pyrimidine bases (thymine, cytosine, and uracil) as well as with nucleic acids (DNA and RNA), a C_4-cycloaddition of furocoumarins to the 5,6-double bond of pyrimidine bases takes place. The simple photoadducts furocoumarin-pyrimidine base can be split by reirradiation at wavelengths shorter than 334 nm. Reactivation of bacterial cells photodamaged by psoralen (365 nm) was experimentally tried. However, reirradiation at shorter wavelengths and with visible light of the psoralen-inactivated bacteria was without any effect. The inability of the shorter wavelengths to repair this photodamage was probably due to a filter effect of DNA for such wavelengths, as experiments on a DNA-psoralen combination showed. On the other hand, the observed possibility of psoralen to form interstrand cross linkages in the photoreaction with DNA may be significant for explaining the absence of photoreactivation when the inactivated bacterial cells are irradiated with visible light. Angular furocoumarins, e.g., Angelicin, do not form cross-linkings into DNA. If cross-linking is the reason for non-reactivability of the photodamage by furocoumarins, one should be able to reactivate photodamages produced by angular furocoumarins. Studies on these aspects are described. (auth)

15016 ACTION OF GAMMA-RAYS ON PLAQUE-FORMING ABILITY OF A HEAT-INDUCIBLE PROPHAGE. Petranovic, D.; Trgovcevic, Z.; Zgaga, V. (Inst. Ruder Boskovic, Zagreb). Stud. Biophys.; 29: 105-9(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

It has been found that the heat-induction of prophage $\lambda c_I 857$ is remarkably reduced by gamma rays. This effect is diminished when early steps of phage development are induced by an appropriate pulse-heating treatment before irradiation. It is therefore proposed that the early events following derepression (detachment of prophage and/or synthesis of early phage-specific products) are made impossible as a consequence of the radiation-induced damage to lysogen. (auth)

Radiation Effects on Plants

15017 (EUR-4899) APPLICATION OF ATOMIC ENERGY IN AGRICULTURE. Annual Report, 1971. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). 1972. 157p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 195.-.

Results are reported from mutation breeding studies on barley, wheat, peas, and tomatoes following exposure of seeds to various doses of γ or x radiation and on apples, carnations, and chrysanthemums following exposure of cuttings and clones. The sterile male technique was tested for the radiation control of the onionfly (Hylemya antiqua). Food preservation studies included tests on the radioinduced inhibition of sprouting of onions and potatoes; tests on the storage life of γ-processed prepackaged endive, asparagus, and peeled potatoes. The growth rate of various bacteria isolated from irradiated meat on γ-irradiated proteins (egg white and gelatin) was investigated. Tracer techniques were used to study nutrient uptake from soil by plants following fertilizer application and mechanisms for the transport of calcium, phosphorus, and nitrogen through soils. Mechanisms involved in the transport of ^{137}Cs and ^{85}Sr through soil were also investigated. Applications of radiographic techniques in the diagnosis of dry rot in old trees were tested and results using a phantom tree appeared promising. (CH)

15018 (SGAE-2053) USE OF IONIZING RADIATION IN PLANT BREEDING. Haunold, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf, Institut fuer Landwirtschaft). Oct 1972. 17p. (In German). Dep. NTIS (U. S. Sales Only).

A brief review is presented of research on plant breeding using ultraviolet, x, and gamma radiation, alpha particles, beta particles, protons, and neutrons. Some topics discussed are: stimulating effects of low doses of radiation on growth, quality, and yield of plants; mutagenic effects of higher doses; relationships between mutation rate and dose; effects of factors such as oxygen and water content and storage time of seeds on radioinduced mutations; comparison of effects of ultraviolet and x radiation on structural changes; comparison of effects of duration of radiation exposure using equal total doses; comparative radiosensitivity of different plant species; radioprotective effects of SH groups; relationships between nuclear volume, DNA content of nuclei, and radiosensitivity of plant species; and mutagenic effects of dominant and recessive genes. (HLW)

15019 (SGAE-LA-6/1971) EFFECT OF γ IRRADIATION ON GROWTH, YIELD, AND N CONTENT OF THE SPRING WHEAT VARIETIES, ADUR AND SVENNO. Zvara, J.; Haunold, E. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Vienna). Sep 1971. 14p. (In German). INIS.

In laboratory and greenhouse experiments the influence of γ irradiation of seed, (0, 100, 500, 1000, 5000, and 10,000 rad), fertilization, and variety on growth, yield, and nitrogen content of the kernels of spring wheat was studied. Seed irradiation caused a growth retardation as shown by emergence, development of the seedlings, and number and fresh weight of shoots per pot. By harvest time growth retardation was not noticeable. Kernel yield decreased following exposure to 1000 rad and straw yield decreased in the second generation from 10,000 rad up. The nitrogen content of kernels increased with dose, however, the variations from season to season were greater than the stimulation effect caused by the irradiation. Top dressing with fertilizer caused yield increases in all cases. (auth)

15020 MEIOTIC ABNORMALITIES INDUCED BY GAMMA RAYS IN VINCA ROSEA LINN. Sudhakaran, I. V. (Inst. of Science, Bombay). Cytologia (Tokyo); 36: No. 1, 67-79(Mar 1971).

Various meiotic abnormalities were studied in pollen mother cells (PMC's) of plants grown from seeds irradiated with various doses of gamma rays. The timing of onset of meiosis is highly disturbed in these plants. Prophase chromosomes exhibit stickiness and clumping and towards the end of prophase irrespective of the dosage, the cells contain fragments of chromosomes, univalents, and disturbed bivalent associations resulting in different configurations of chromosomes. The number of fragments and chromosome chains appearing as multivalents become more apparent towards the end of diakinesis. Chromosomes of different configurations including fragments are delayed in metaphase orientation and they are seen scattered or in groups in the cytoplasm. The disturbed formation of the spindle and the orientation of chromosomes in groups in the metaphase are remarkably high PMC's. In anaphase formation of micronuclei of different numbers and sizes, lagging chromosomes, fragments of chromosomes

and chromatids, and bridges with or without fragments are also very common. The frequency of occurrence of fragments is proportional to the dosage of gamma rays and also the presence of multivalents increases with the dose. These abnormalities seem to induce pollen sterility which is proportional to the dose of gamma rays. This pollen sterility seems to be the cumulative result of various aberrant meiotic stages as well as physiological and genetic damages induced by the breakage of chromosomes. (auth)

15021 STUDIES ON THE RADIATION BREEDING IN THE GENUS MENTHA. 13. EFFECTS OF IRRADIATION ON POLLEN. Ono, Seiroku (Okayama Univ., Japan). Okayama Daigaku Nogabuku Gakujutsu Hokoku; No. 39, 1-8(Mar 1972).

The effects of irradiated pollen grains on pollen tube mitosis were investigated. The data were obtained from artificial cultures. For irradiation gamma rays were applied with ^{60}Co at a dose rate 65 KR/hr. The doses ranged from 1 to 80 KR. The following results were obtained. Inhibition of mitosis increased with increasing dose; namely the higher the dose, the more reduced was the frequency of nuclear division and the more delayed was the time of its occurrence. In M. rotundifolia the generative nucleus remained mostly undivided at 5 KR, while at 20 KR a few nuclei consisted of chromatin masses or chromosomes. The pollen tubes of M. rotundifolia did not grow smoothly on the media. In natural conditions, therefore, the pollen-tube mitosis of this plant may be more radioresistant. At 80 KR irradiation of M. spicata pollen the mitotic division of the generative nucleus was almost completely inhibited. In M. arvensis the generative nucleus did not divide into 2 sperm nuclei above 25 KR, while relatively many generative nuclei with chromosomes were observed at 50 KR. The pollen grains of M. arvensis L. var. piperascens had the highest radioresistance. At 50 to 80 KR the generative nucleus underwent complete mitotic division. Radiosensitivity of pollen grains varied widely according to the species. In general, pollen-tube mitosis was much more radio-resistant than the meiosis in pollen mother cells and mitosis in root tips. (auth)

15022 EFFECTS OF SEASON OF GAMMA RAY IRRADIATION, PRUNING, AND INTERNAL DISBUDDING ON INDUCTION OF SOMATIC MUTATIONS IN KUMA-SUGI, CRYPTOMERIA JAPONICA D. DON. Ohba, Kihachiro (Inst. of Radiation Breeding, Ibaraki, Japan); Murai, M. Nippon Rin Gakkai-Shi; 53: No. 6, 170-6(Jun 1971). (In Japanese).

Saplings planted in pots were exposed to γ rays of 580 R at a rate of 96.7 R/day (20h) for combined treatments of irradiation and pruning. The irradiation was carried out in June, August, and October, and the pruning condition was no-, light- and heavy pruning, just after the irradiation. Detection of somatic mutation was continued until winter of the next year, and the somatic mutations were classified into five categories: chlorophyll change, waxless change, morphological change in needles, change in winter coloration of green tissues, and morphological anomalies. The highest somatic mutation rate per shoot was 2.13% and obtained in the August irradiation. The heavy pruning made just after the irradiation was found to be ineffective for inducing the somatic mutations. In the August irradiation, the rate of chlorophyll mutation was comparatively low, and changes in wax coating and needle morphology were more frequent than those in the other irradiation seasons. Moreover, in upper crown of the saplings, the somatic mutation rate was always higher than that in lower crown. (auth)

15023 CURVED SPINE MUTANT IN SOLANUM KHASIANUM CLARKE, INDUCED BY γ-RADIATION. Bhatt, B. (Bhabha Atomic Research Centre, Trombay, India). Curr. Sci. (India); 41: No. 24, 889-90(20 Dec 1972).

Experiments were undertaken to obtain plants of Solanum khasianum without the sharp spines present in all parts of the plant. Seeds were treated with 5- to 35-kR doses of gamma radiation and sown in pots. Fifty seedlings from each surviving dose group were transplanted in the field and fruits were collected for studies on the M_2 generation. A mutant with thick curved spines was found and studies of this mutant indicated that the plants were normal with regard to pollen fertility and other characteristics. The mutant plants were taller and the yield was higher than that of controls. (HLW)

15024 INACTIVATION OF CYTODUCTANTS IN YEAST (SACCHAROMYCES CEREVISIAE) INDUCED BY THE DECAY OF ^{32}P. Gracheva, L. M.; Korolev, V. G. (Ioffe Inst. of Physics and Tech., Gatchina, USSR). Genetika; 8: No. 10, 121-126(Oct 1972). (In Russian).

Cytoduction (transfer of cytoplasmic hereditary factors) in the course of crossing haploid cells damaged by the decay of ^{32}P was studied experimentally. Cytoduction was shown to be induced efficiently by the decay of ^{32}P, the greatest effect being attained in cases of damage of nucleus in the cell that is the donor of cytoplasm. In such cases the frequency of cytoductants in some experiments exceeded 20% of the total number of colonies grown in Petri dishes. Apparently the induction of cytoductants takes place in the course of crossing parental haploids, the DNA of one or both of which is labelled with ^{32}P, since the accumulation of lesions in the course of storage of zygotes does not lead to any increases in the proportion of cytoductants. On the contrary, the percentage of cytoductants slowly decreased towards the end of the experiment, the decrease being more rapid in zygotes in which both genomes were ^{32}P-labelled, as compared to those in which only one genome was labeled. (auth)

15025 EFFECT OF UV-IRRADIATION AND OF UVS_1-GENOTYPE ON YEAST CYTODUCTION. Zakharov, I. A.; Stepanova, V. P. (Ioffe Inst. of Physics and Tech., Gatchina, USSR). Genetika; 8: No. 10, 105-111(Oct 1972). (In Russian).

The effect of uv light on cytoduction (the autonomous transfer of a cytoplasmic hereditary factor) in yeast Saccharomyces cerevisiae was studied. UV-light induced cytoduction with high frequency (up to 40%), the frequency of the spontaneous cytoduction being 1%. The uvs-genotype of the nonirradiated parent influenced the cytoduction frequency. In crosses of irradiated cells with nonirradiated uv-sensitive (uvs_1) strain the frequency of cytoduction was much higher than in crosses with cells of the resistant strain. The most pronounced effect was observed in the case of irradiated uvs_1 cells. (auth)

15026 EFFECTS OF GAMMA IRRADIATION ON GROWTH AND ENERGY METABOLISM OF WHEAT SEEDLING. Srivastava, H. K. (Haryana Agricultural Univ., Hissar, India). Curr. Sci. (India); 42: No. 3, 81-84(5 Feb 1973).

Seedling growth is inhibited by 40 to 70% at low doses of gamma irradiation from 10 to 30 kR. The activities of mitochondrial adenosine triphosphatase and inorganic pyrophosphatase from cell-free preparation during early development of seedlings from irradiated seeds are significantly reduced. The results are discussed from the point of view that some disturbances in the biosynthetic pathways in irradiated seeds at the later stages cause the production of insufficient amount of enzymes which in turn result in reduced growth and development of such plants. (auth)

15027 MUTAGENIC EFFECT OF FAST NEUTRONS ON LENS ESCULENTA (MOENCH). Uhlik, J. (Agricultural Univ., Prague). Genet. Slechteni; 8: No. 1, 21-8(Jan 1972). (In Czech).

The mutagenic effect of fast neutron irradiation on the lentil of Lens esculenta (Moench) strain was studied. The cyclotron installed at the Institute of Nuclear Research at Řež, near Prague, was used for the purpose. Fast neutron irradiation was found to induce a very high proportion of segregating offspring with chimeras and a high number of chimeric plants. Of the respective kinds of mutants in one offspring generation, considerably high rates of viridis mutants and of chimeric plants were observed. Important also was the ability of fast neutrons to induce a number of combinations of different kinds of chlorophyll mutants in the same generation of offspring. The variations were studied of the number of various kinds of chlorophyll mutants and of their various combinations with the dose of neutron radiation. The results are tabulated. (NSA of Czech)

15028 EFFECTS OF X-RAYS ON SEED GERMINATION AND GROWTH OF SCOTS PINE (PINUS SILVESTRIS L.) SEEDLINGS OF DIFFERENT PROVENIENCE. Nalborczyk, E.; Zelawska, B.; Kolakowska, M. (Warsaw Agricultural Univ.). Acta Soc. Bot. Pol.; 40: 403-12(1971).

The effect of x radiation on germination of seed and growth of seedlings of Scots pine was investigated. Higher radioresistance of seed originating from the highland region was established. No difference was found in the investigated seed samples in the content of cysteine and content and composition of the chloroform-soluble fraction. Differences in compounds contained in the chloroform-soluble fraction and in the rate of phosphorus uptake were found in young seedlings from different sources. They possibly are related to the difference in the ability of seedlings to regenerate the postirradiation damage. (auth)

15029 EFFECT OF TREATMENT OF X-RAYS ON PLANT GROWTH, FLOWERING, AND FRUITING IN CATHARANTHUS ROSEUS (L) G. DON SYN. VINCA ROSEA L. Bose, S.; Gupta, S.; Banerjee, B. (Univ. of Calcutta). Sci. Cult. (Calcutta); 38: No. 4, 196-8(Apr 1972).

Seeds of periwinkle plants were x-irradiated in doses of 10, 20, and 30 kR. Observations were made on the number of plants surviving to maturity, number of branches per plant, earliest flowering date, pollen sterility, and number of seeds per fruit. Cytological studies revealed chromosome aberrations. Results are tabulated. (HLW)

15030 NUTRITIONAL STATUS OF GAMMA IRRADIATION INDUCED MACROMUTANTS OF PHASEOLUS VULGARIS L. cv. BLUE LAKE. Mujeeb, K. A. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Radiat. Bot.: 12: No. 6, 369-372(Dec 1972).

Four radioinduced macromutants, semi-dwarfs (SDM-1, SDM-2), pod-shape/high yielding (PSHy), and late flowering/high yielding (LfHy), of Phaseolus vulgaris L. cv. Blue Lake were evaluated for protein and amino acid levels after the M_4 generation. The total protein contents were similar. LfHy was lower in threonine content when compared with its Blue Lake parent (control). Protein quality requirements based on lysine level were higher for LfHy and PSHy, with the semi-dwarfs being lower than LfHy and PSHy, but similar to control. In satisfying the threonine requirements PSHy was superior, and LfHy lower than the control. All comparisons were significant at the 5% level. The not significantly different ratios of essential to total amino acids ranged from 0.48 to 0.51 for the macromutants as against 0.50 for the control. The results indicate that the four macromutants would be of considerable interest either for subsequent direct utilization (PSHy and LfHy), or for recombination (SDM-1, and SDM-2). (auth)

15031 RADIOSENSITIVITY OF PHASEOLUS VULGARIS L. cv. BLUE LAKE. MORPHOLOGICAL AND PHYSIOLOGICAL CRITERIA. Mujeeb, K. A.; Greig, J. K. (Kansas State Univ., Manhattan). Radiat. Bot.: 12: No. 6, 437-439(Dec 1972).

Phaseolus vulgaris L. cv. Blue Lake seeds were given acute gamma radiation exposures of 1.0, 1.5, 2.0, 2.5, 3.0, 3.5, 4.0, 4.5, 5.0, and 7.5 kR from a 4500 Ci ^{60}Co source. Leaf-disk samples from primary leaves, collected 21 days after seeds were planted, were analyzed for total chlorophyll. Germination and seedling height, determined at the same time, were used to estimate seedling performance, (germination x seedling height, as per cent of respective controls). Leaf spotting progressed with ascending dosage. Highly significant negative correlations to exposure were found for total chlorophyll content and seedling performance. The morphological and pigment criteria differed significantly in estimating biological response, yielding D_{50} values of 4.5 kR and 6.3 kR, respectively. The pigment criterion was suggested to provide greater mutability in M_2. (UK)

Radiation Effects on Animals

Man

Refer also to abstract 16401.

15032 (AD-745775) ANNUAL RESEARCH REPORT, 1 JULY 1970-30 JUNE 1971. (Armed Forces Radiobiology Research Inst., Bethesda, Md.). 30 Jun 1971. 67p. (AFRRI-ARR-5). NTIS.

15033 (CONF-721204-1) CALCULATION OF DOSE TO SELECTED ORGANS FROM MONOENERGETIC X-RAY BEAMS INCIDENT ON A HETEROGENEOUS AND ANTHROPOMORPHIC PHANTOM. Poston, J. W.; Warner, G. G. (Oak Ridge National Lab., Tenn.); Rosenstein, M.; Schneider, R. H. (Bureau of Radiological Health, Rockville, Md.). 1972. 17p. Dep. NTIS.

From 7th midyear topical symposium on health physics in the healing arts; San Juan, PR (11 Dec 1972).

This paper describes an approach to the calculation of average absorbed dose in several internal organs per unit of incident radiation exposure for external x-ray beams in the medical diagnostic photon energy range. The purpose of the calculations is to obtain a complete set of basic dosimetry data for selected photon energies on a spatial grid from which one can construct certain organ doses from typical diagnostic x-ray exposures of specified average energy or energy spectrum and varying field size and location. The calculations make use of Monte Carlo computer techniques that simulate photon transport through material by generating photon trajectories and energy loss histories from random samples of the known probability distributions of the possible interactions. The energy deposition is recorded in a mathematical representation of an anthropomorphic and heterogeneous phantom previously developed by Snyder and co-workers at the Oak Ridge National Laboratory and modified for the present work to include lenses of the eye, a diagnostic x-ray table, and the presence of iodine in the thyroid. The computer code includes regions of tissue, skeletal, and lung density, and mathematically defined internal organs. The primary organs of interest in the study were the gonads, red bone marrow, thyroid, and lens of the eye. Preliminary data for 4 cm × 4 cm beams impinging on the trunk of the phantom for photon energies of 30 and 55 keV are presented for the ovaries. (auth)

15034 (N-72-18077) RADIATION HAZARDS TO MAN. Curtis, S. B.; Wilkinson, M. C. (Boeing Co., Seattle, Wash.). 12 Apr 1971. Contract NASw-1963. 46p. (NASA-CR-125592; D-180-12878-1). NTIS.

The secondary dose contribution expected from the heavy primaries of the galactic cosmic rays was evaluated by a calculational technique developed in this study. Improvements in the solar and galactic cosmic ray environments made possible by recent experimental and theoretical work are discussed and presented. The recommendations of the National Academy of Sciences' space radiation study panel are used in conjunction with a shielding analysis, to evaluate the radiation status of an astronaut during the triple solar particle event of 10, 14, 16 July 1959. (auth)

15035 (N-72-26051) VISUAL PHENOMENA INDUCED BY COSMIC RAYS AND ACCELERATED PARTICLES. Tobias, C. A.; Budinger, T. F.; Leith, J. T.; Mamoon, A.-M.; Chapman, Philip (National Aeronautics and Space Administration, Houston, Tex. Manned Space Flight Center. California Univ., Berkeley). Mar 1972. 12p. (NASA-TM-X-68460). NTIS.

Experiments, conducted at cyclotrons together with observations by Apollo astronauts, suggest that cosmic nuclei interacting with the visual apparatus cause the phenomenon of light flashes observed by astronauts during the past four Apollo missions. Other experiments with high- and low-energy neutrons and a helium ion beam suggest that slow protons and helium ions with a stopping power greater than 10^8 eV/gram/sq cm can cause the phenomenon in the dark-adapted eye. It was demonstrated that charged particles induced by neutrons and helium ions can stimulate the visual apparatus. Some approaches to understanding the long-term mission effects of galactic cosmic nuclei interacting with man and his nervous system are outlined. (auth)

15036 (NRC-TT-1609) RESEARCH AND DEVELOPMENT OF RADIATION-PROTECTIVE AGENTS (NOW BECOMING AVAILABLE AS ORAL DRUGS). Akaboshi, Sanya. Translated by Makoto Inaba (National Research Council of Canada, Ottawa), from Genshiryoku Kogyo; 17: No. 2, 51-4(1971). 13p. Dep. NTIS (U. S. Sales Only).

An English language translation is presented of a review of recent research on various aspects of radiation protection. The book, A Guide to Radiation-Protective Agents, is briefly reviewed. The first chapter discusses methods by which man is exposed to radiation: occupational, medical, exposure to atomic bomb explosions and accidents, and exposure to fallout. Other chapters discuss the present status of radioprotective agents against external and internal radiation and procedures for dealing with radiation injuries. The effectiveness of radioprotective drugs administered orally is discussed with emphasis on derivatives of AET, and experiments with mice to determine the effectiveness of unknown drugs are described. The advantages of testing by oral administration over intravenous injection are discussed. The drugs, adrenochrome monoguanylhydrazone methanesulfonate and L-cysteine ethyl ester hydrochloride, are discussed with regard to effectiveness of oral administration. Experiments to determine the protective effects of L-cysteine ethyl ester hydrochloride on x-irradiated mice are described. (HLW)

15037 (ORO-4002-3) EFFECTS OF X-IRRADIATION ON THE HUMAN TESTIS: AN ELECTRON MICROSCOPIC CYTOCHEMICAL STUDY. Progress Report, November 15, 1971-December 31, 1972. Berlin, J. D. (Texas Tech Univ., Lubbock (USA)). 1973. Contract AT(40-1)-4002. 7p. Dep. NTIS.

Normal human testes that had received irradiation at doses of 20, 78, 200, and 600 R were subjected to an electron microscopic cytochemical examination. Samples were obtained from 15 min to 7 yrs postexposure. Morphological changes observed after irradiation included spermatogonial degeneration, increased numbers of lysosomes in Sertoli cells, mitochondrial alterations and cytoplasmic vacuolization in spermatogenic cells, and abnormal acrosomes. Enzymic alterations observed after irradiation were an initial transitory increase in acid phosphatase activity in the Sertoli cells (thought to be related to spermatogonial phagocytosis by the Sertoli cells), a dose and time dependency in the decreased activity of thiamine pyrophosphatase, a time dependency in the decreased activity of inosine diphosphatase, and a displacement in the localization of glucose-6-phosphatase. No changes were observed in adenosine mono- or triphosphatase activities following irradiation. (auth)

15038 (TID-26245) PROTECTION AGAINST RADIATIONS FROM ^{252}Cf. STATUS OF RADIOBIOLOGY STUDIES WITH ^{252}Cf AS OF APRIL 1972. Medical Guidance No. 3. 1972. 16p. Dep. NTIS.

Californium-252 decays by α emission and spontaneous fission, with half-lives for the two processes of 2.6 and 85.5 years, re-

spectively. It is the spontaneous fission that results in the mixed neutron and γ emission that makes the nuclide of such medical interest for use as an implant or intracavitary radiation source for therapy, but it is the α emission that dictates the half-life of a ^{252}Cf source that is, therefore, inconveniently short at about 2.6 years. Under conditions of minimum scatter, 37% of the absorbed dose in tissue results from the γ ray contribution, most of which is in the 0.5- to 1.0-MeV range. The remaining 63% of the dose is contributed by fission spectrum neutrons having an average energy of 2.3 MeV and a modal energy of about 1 MeV. The ratio of neutrons to γ rays varies with distance from a ^{252}Cf source when the source is imbedded in a tissue equivalent phantom. The experimental data available for the mixed neutron and γ emission from ^{252}Cf are reviewed. Since the potential advantage of this nuclide rests entirely upon the lower value for the oxygen enhancement ratio (OER) all reported measurements of this parameter are critically reviewed. In addition, the experimental data concerning the relative biological effectiveness of ^{252}Cf radiation relative to ^{226}Ra γ rays is summarized, so that dosage schedules can be predicted for use in humans. It was calculated that a dose of about 900 rads of ^{252}Cf neutrons would be equivalent to 6000 rads of radium γ rays if both are given in about seven days. Since the neutron to γ ratio is variable, and since neutrons are so much more effective than γ rays, it is dangerous and inadvisable to refer to the total dose from ^{252}Cf; it should always be separated into its component parts. (CH)

15039 IONIZING RADIATION: LEVELS AND EFFECTS. VOLUME I. LEVELS. New York; United Nations (1972). 200p. $7.00.

The book is a report of the United Nations Scientific Committee on the Effects of Atomic Radiation to the General Assembly. The first volume contains four chapters that discuss sources and doses of radiation, genetic effects of radiation, effects of radiation on the immune response, and radiation carcinogenesis. The following appendices are included: list of scientific experts, members of national delegations; list of scientific experts who have cooperated with the Committee in the preparation of the report; and list of reports received by the Committee. The following annexes are included: environmental radiation; doses from medical irradiation; doses from occupational exposure; and miscellaneous sources of ionizing radiation. (H.L.W.)

15040 IONIZING RADIATION: LEVELS AND EFFECTS. VOLUME II. EFFECTS. New York; United Nations (1972). 254p. $7.00.

The second volume of the report of the United Nations Scientific Committee contains four annexes. The first annex discusses genetic effects of ionizing radiation on mammals, fish, and insects, and effects at the cellular and molecular levels. The second annex discusses effects of radiation on the immune response under the following headings: the general components of the immune response; effects of radiation on susceptibility to infection; effects of radiation on antibody formation; effects of radiation on cellular immune reactions; radiation and immunological tolerance; immunological aspects of carcinogenesis; and effects of variation of condition of irradiation on immunological responses. The third annex discusses experimental induction of neoplasms by radiation; some topics discussed are the role of animal experiments in predicting radiation carcinogenesis in man; special problems of internal emitters; tissues at risk; dose-effect relations; and dependence of sensitivity on age. The fourth annex discusses radiation carcinogenesis in man under the following headings: leukemia; thyroid neoplasms; breast cancer; lung cancer; bone tumors; other cancers; malignancies in children; and malignancies in prenatally exposed children. (H.L.W.)

15041 RHABDOMYOSARCOMA OF HEAD AND NECK IN CHILDREN. COMBINATION TREATMENT BY SURGERY, IRRADIATION, AND CHEMOTHERAPY. Donaldson, S. S.; Castro, J.R.; Wilbur, J. R.; Jesse, R. H. Jr. (M. D. Anderson Hospital and Tumor Inst., Houston, TX). Cancer; 31: No. 1, 27-35(Jan 1973).

Combined systematic therapy offers the best chance of cure for children with rhabdomyosarcoma originating in the head and neck. Recommended therapy includes: local excision or biopsy; radiation therapy with doses of 6,000 rads/6 weeks; and multi-drug chemotherapy, i.e., vincristine sulfate, actinomycin D, and cyclophosphamide. Severe ocular, dental, soft tissue, and possibly bone complications may be encountered. Provision for prompt medical and nursing support must be available for possible associated morbidity. Of 19 patients treated, minimum 2-year survival is 74%, and local control 89%. Late recurrences or complications require further follow-up. (auth)

15042 MALIGNANT TUMORS OF THE VAGINA. Perez, C. A.; Arneson, A. N.; Galakatos, Andrew; Samanth, H. K. (Washington Univ., St. Louis). Cancer; 31: No. 1, 36-44(Jan 1973).

A retrospective analysis of 118 patients with malignant tumors of the vagina shows that the prognosis, following adequate irradiation, is similar to comparable stages of carcinoma of the cervix. The 5-year absolute cure rate was 75% for Stage I, 50% for Stage IIA, and about 25% for Stages IIB, III, and IV. The patients were retrospectively staged according to the system adopted by the International Federation of Gynecology and Obstetrics. It is proposed that the Stage II lesions be subdivided into IIA (paravaginal submucosal extension only) and IIB (parametrial extension), since the prognosis is distinctly different in these patients. Otherwise, the prognosis correlates well with the various clinical stages. Tumor control was excellent in the in-situ and early invasive lesions treated by radium alone or combined with external beam in Stage I lesions. Local and pelvic failures were more frequently seen in tumors more extensive than Stage IIA. Well-planned irradiation, with the aid of computer calculations, will significantly increase tumor control. This is best achieved by combining interstitial and intracavitary vaginal radium and external beam supervoltage irradiation to the pelvic and parametrial tissues. The importance of careful follow-up after irradiation and the early treatment of recurrent lesions is emphasized since a number of these patients can be salvaged by a subsequent surgical procedure. The most significant factor affecting the prognosis was the stage of the disease, which was related to the depth of infiltration of the tumor in the vaginal wall or adjacent tissues. Age of the patient, location, or extent of mucosal involvement did not significantly influence the prognosis. (auth)

15043 CARCINOMA OF LARGE INTESTINE IN PATIENTS IRRADIATED FOR CARCINOMA OF CERVIX AND UTERUS. Castro, E. B.; Rosen, P. P.; Quan, S. H. Q. (Memorial Hospital for Cancer and Allied Diseases, New York). Cancer; 31: No. 1, 45-52(Jan 1973).

Twenty-six patients with carcinoma of colon and rectum following radiation therapy for cancer of the cervix and uterus were analyzed. Nearly two thirds of the patients were more than 60 yrs old. The interval between irradiation and diagnosis of the second tumor varied from 5 to 30 yrs. Despite lack of detailed information on radiation factors in half of the patients, circumstantial evidence from this study suggests that radiation therapy may have contributed to the development of colorectal adenocarcinoma in some of the patients. Among the findings supporting this conclusion in this series are: localization of second tumor at site of radiotherapy; 58% of the patients had symptomatic and clinically documented chronic radiation proctocolitis at sites of subsequent tumor; 69% of the patients had post-irradiation interval of more than 10 yrs; 58% of the patients had histologic proof of radiation-related alterations in involved bowel segment; and occurrence of a much higher than expected percentage (58%) of mucinous (colloid) adenocarcinoma in involved region, of which 92% had clinical and/or histologic evidence of radiation proctocolitis. The overall and determinate 5 yr survival in this series was 20% and 22%, respectively. It, therefore, behooves the clinician to be vigilant in the follow-up of these patients who are long-term survivors of radiation-treated carcinoma of the cervix and uterus for the late development of colorectal carcinoma. (auth)

15044 WHITE SPOT DISEASE DEVELOPED AFTER X-RAY IRRADIATION. Ladanyi, Eva. Magy. Radiol.; 24: No. 6, 366-369(Dec 1972). (In Hungarian).

No previous reports of skin diseases induced by x radiation have been found in the literature. The differential diagnosis of this disease, verified by histological examination, is discussed. (HLW)

15045 RIB FRACTURES FOLLOWING RADIATION THERAPY FOR CANCER OF THE LUNG. Ogawa, Fumiaki (Kyoto Prefectural Univ. of Medicine); Hayashi, Shigejiro; Murakami, Koichi; Takaoka, Ataru. Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 4, 308-319(Jul 1972).

The five-year survival rate after radiation therapy of cancer of the lung generally does not exceed about 10%. It should be pointed out that these low survival rates are due to the advanced stage of the disease and the age of the patients when admitted to the hospital. It is easy to supply a sufficient tumor lethal dose to the primary tumor by employing high-energy irradiation, but the damage of normal tissues of the lung becomes one of the most important factors. The purpose of this report is to review long-term survivors with rib fracture following radiotherapy for lung cancer and to study the incidence of rib fracture and the relationship between rib dose and time of appearance of rib fracture. The incidence of rib fractures following radiation therapy for cancer of the lung was 5/29 (17.2%). A positive correlation was observed between the incidence of rib fractures and the rib dose. There was no relationship between the rib dose and time of appearance of rib fractures.

In the cases in which both rib fracture and skin ulceration occurred, the rib fracture preceded the skin ulceration. (auth)

15046 DATA CONCERNING CHANGES IN THE TOTAL NUMBER OF LEUKOCYTE CELLS AND THE ABSOLUTE LYMPHOCYTE NUMBER OF YOUNG ADULT TUMOR PATIENTS AFTER AND DURING RADIATION TREATMENT. Kertesz, Frigyes. Honvedorvos; 24: No. 3, 210-224(1972). (In Hungarian).

Changes in the leukocyte number and the absolute lymphocyte number of 39 patients between 20 and 35 yrs of age and 40 older patients, treated during the period 1963 to 1968 at the Radiation Therapy Department of the Central Military Hospital by stomach and chest irradiation, were analyzed. In selecting the case histories, care was taken to eliminate patients who exhibited phenomena, such as bleeding, which cause leukocyte or lymphocyte depression. After the first week of treatment, the leukocyte number was found to show an identical behavior in patients within the same age group; the lymphocyte number could be grouped according to the part of the body subjected to irradiation. At the end of the treatment, the values were found to even out, except for the changes in the lymphocyte number of the young adult group. The smaller decrease exhibited by that group was attributed to the lower total dose to which the individuals in question were exposed. No conclusions could be drawn from the course of the absolute lymphocyte number during leukopenia and that related to regeneration because the number of cases was too small. (TTT)

15047 RADIATION-INDUCED SKIN ULCERATION. A STUDY OF FIVE PATIENTS. Ogawa, Fumiaki (Kyoto Prefectural Univ. of Medicine); Nishiguchi, Hiroyasu; Murakami, Koichi; Matsuki, Masayoshi; Takaoka, Ataru. Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 4, 299-307(Jul 1972).

Five patients with radioinduced skin ulceration are described. Skin ulceration is one of the most severe late skin reactions. The larger the dose the sooner it develops. A linear relationship was observed between the logarithm of the time of appearance after irradiation and the nominal single dose (NSD) expressed in ret, although the number of cases used to determine this relationship was small. NSD as reported by F. Ellis is thought to be a useful parameter to express the radiation effect in normal tissues. Even in patients receiving low doses (NSD less than 1,500 ret), skin ulceration developed more than 10 years after radiation therapy. (auth)

15048 EXTRACORPOREAL IRRADIATION OF BLOOD WITH A 250 kV X-RAY APPARATUS. Birkeland, S. A.; Munk, J. (Odense Sygehus, Denmark). Dan. Med. Bull.; 19: No. 7, 209-214(1972).

For immunosuppressive treatment in renal transplantation, with the aim of preventing graft rejection, prednisolone and azathioprine are routinely employed, but several transplant centers use additional methods, such as extracorporeal irradiation of the blood, drainage of the thoracic duct, and antilymphocyte serum. The blood is irradiated while outside the organism, which is thus unaffected by the radiation. The lymphocytes are the most radiation-sensitive cells in the blood. The lifetime of the lymphocytes is very long (months to years). There is a constant recirculation between blood and lymphoid tissue. It is therefore possible, by means of repeated irradiation over a prolonged period, to subject a considerable proportion of the lymphocytes to a prolonged effect. The lymphocytes play an important role in the immunological response of the organism to the introduction of a foreign organ. This is true for both the afferent as well as the efferent part of the transplant reaction. The treatments may be administered alone or simultaneously with hemodialysis treatment. ECIB was used for 18 months with various types of irradiation apparatus. The clinical experience with a conventional x-ray apparatus is described. (auth)

15049 REDUCTION OF DOSE CONTRIBUTING TO NATIONAL GENETICALLY SIGNIFICANT DOSE. Kawasaki, K. (Anti-Tuberculosis Association, Tokyo). Nippon Hoshasen Gijutsu Gakkai Zasshi; 27: No. 3, 180-204(Oct 1971). (In Japanese).

In order to reduce the radiation dose from medical uses of x radiation contributing to the national genetically significant dose, all possible means should be considered to assure the best interests of patients with the least dose. Procedures to be carried out for the above purpose include regulation of the irradiation field or protection of part of the body during therapy. Filter plates should be controllable according to the tube voltage utilized. During diagnostic radiography improvement of photographing conditions, especially switching to high voltage photographing, should be considered. The equipment should be correctly controlled by automatic timers. Autodevelopers should also be well controlled. High sensitivity paper, high brightness fluorescent plates, and high sensitivity films should be used. The most fundamental point is the thorough education and training of personnel in methods for protection against x rays. (Japan)

15050 BONE MARROW DAMAGE FOLLOWING TOTAL NODAL IRRADIATION IN HODGKIN'S DISEASE PATIENTS. Cionini, L. (Univ., Florence). Brit. J. Radiol.; 46: No. 541, 67-68(Jan 1973).

The ability of γ-irradiated bone marrow to concentrate ^{59}Fe was studied in nine patients treated by total nodal irradiation for Hodgkin's disease, by measuring the surface radioactivity over the sacrum after intravenous injection of a tracer dose of the isotope. The radiation tumor dose was usually 3,600 to 4,000 rads in 4 to 5 weeks, 5 fractions a week. The irradiated sacral marrow appeared to concentrate ^{59}Fe to a definitely lower grade than normal bone marrow in 4 patients examined at 1¾, 3½, 6½, and 7 months after the end of radiotherapy. In the 5th patient, examined 4 years after the end of radiotherapy, the curve of the sacral radioactivity just attained to the lower borderline of the normal range. In 3 patients examined at 4, 9, and 10 months after the end of radiotherapy, the curves lay within normal range. In the one in whom abdominal treatment had been stopped at 1,620 rads because of lencothrombocytopaenia and haemorrhaages, the sacral bone marrow appeared hyperative. (UK)

15051 EXPOSURE PATTERN, SURFACE, BONE MARROW INTEGRAL AND GONADAL DOSE FROM FLUOROSCOPY. Takeshita, K.; Antoku, S.; Sawada, S. (Atomic Bomb Casualty Commission, Hiroshima). Brit. J. Radiol.; 45: No. 529, 53-58 (Jan 1972).

Using industrial x ray film on a phantom human and multiple ionization chambers within the phantom, exposure patterns and radiation doses were assessed for conventional and image amplifier-closed-circuit television fluoroscopy. Results are expressed as bone marrow integral, gonadal, and surface doses. Procedures by both radiologists and non-radiologists during upper gastrointestinal series, following barium enemas, and chest fluoroscopy were carefully analysed. There was a wide range in exposure patterns and dose not only between radiologists and non-radiologists, but within each of these two categories of examiners. Average doses for each of these examiner categories are included. They are for reference and are being used in estimating dose from medical x rays among atomic bomb survivors and comparison subjects and the general populations of Hiroshima and Nagasaki. (auth)

15052 EXPOSURE CHARACTERISTICS OF DIAGNOSTIC X-RAY MACHINES. Holloway, A. F.; Campbell, E. M.; Essenburg, A. (Manitoba Cancer Treatment and Research Foundation, Winnipeg, Canada). Brit. J. Radiol.; 45: No. 529, 48-52(Jan 1972).

Results of exposure and quality measurements carried out on 199 diagnostic x-ray installations are presented. In addition, the exposures that would be incident on the entrance surface of patients undergoing upright postero–anterior chest radiography are reported for 108 of these installations, and the exposure rates at the fluoroscope panel under conditions employed for normal gastric fluoroscopy are reported for 37 of them. A spread in radiographic exposure rates and exposure rates at the fluoroscope panel of as much as by a factor of 5 is indicated when the units are operated under similar conditions. The variation in patient exposure is even greater for chest radiography. The HVTs for practically all of the units are reported as being between 2.0 and 4.0 mm Al. (auth)

Vertebrates

Refer also to abstract 15105.

15053 (ORO-3882-12) MECHANISM OF RADIATION EFFECTS ON THE TRANSPORT AND BIOELECTRIC PROPERTIES OF RAT INTESTINE. Progress Report, January 1, 1969–December 31, 1972. McKenney, J. R. (Medical Coll. of Georgia, Augusta). 1972. Contract AT(40-1)-3882. 25p. Dep. NTIS.

The effects of ionizing radiation responsible for the breakdown of salt, fluid, and nutrient absorption were studied. Effects of both acute radiation exposure and bile diversion were studied. Results indicate that after 1200 R radiation, salt and glucose transport are transiently elevated with subsequent depression of salt transport by the third day and glucose transport by the fourth day. Transmission and scanning electron microscopy show related effects on cellular structure. The unidirectional flux of glucose following x irradiation is a predictable function of the unidirectional flux for Na^+. HCO_3^- appears to be the predominant co-anion in glucose facilitated Na^+ transport as opposed to Cl^- in salt transport. Unidirectional electrolyte and water fluxes were coupled. Bile diversion caused a several-fold increase in the unidirec-

tional flux of glucose. This research was performed with isolated rat intestine and included flux measurements with radioisotopes and glucose, intracellular voltage measurements, and electron microscopy. (auth)

15054 (UCD—34-P-187-3) HEMATOPOIETIC REPOPULATION FOLLOWING IRRADIATION INJURY. Progress Report, June 1, 1971—August 31, 1972. Lewis, J. P.; O'Grady, L. F. (California Univ., Davis. School of Medicine). 1972. Contract AT(04-3)-34. 10p. Dep. NTIS.

Mice were exposed to radiation doses of 700 to 875 R, and the effects of splenectomy and transplants of syngeneic bone marrow cells on recovery from radiation injuries were studied. Just prior to death from radiation injury a consistent bacteremia was not observed. Although splenectomy did not affect radiosensitivity, it was found that the spleen played an important part in recovery of the peripheral blood count. Ferrokinetic studies showed that ^{59}Fe uptake was greater in mice with spleens than in splenectomized mice. Erythropoiesis was more active in femurs of splenectomized mice indicating that in the absence of the spleen the marrow is able to respond by producing a greater number of red cells. Injections of bacteria, Listeria monocytogenes, were given to some mice and it was found that lethally irradiated marrow-transplanted mice tolerated the bacteria better than did the sublethally irradiated mice. (HLW)

15055 METABOLISM OF EXOGENOUS HIGH POLYMER ^{14}C-DNA IN NORMAL AND IRRADIATED ANIMALS. Rubachev, P. G.; Fedorova, T. A.; Mazurik V. K.; Skurikhina, A. M. (Inst. of Biophysics, Moscow). Stud. Biophys.; 29: 153-9(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The effects of whole-body x irradiation on the metabolism of injected ^{14}C-labeled high-polymer DNA were studied in rats. Among the parameters studied were rate of disappearance from injection site, degradation to terminal products, and kinetics of distribution in blood and organs. (ERB)

15056 PROBLEM OF PARTICIPATION OF EXOGENOUS DEOXYRIBONUCLEIC ACID IN THE PROCESS OF REPAIR. Slotova, J.; Karpfel, Z. (Inst. of Biophysics, Brno). Stud. Biophys.; 29: 161-8(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The effects of syngeneic DNA on the repair of x-irradiated or chemical mutagen-treated bone marrow were studied in mice. It was found that exogenously applied syngeneic DNA had a favorable effect on the repair processes in cells injured not only by ionizing radiation, but also by the chemical mutagen. (ERB)

15057 INVESTIGATIONS INTO THE ORIGIN OF SEROTONIN RELEASED BY IONIZING IRRADIATION IN MAMMALS. Veninga, T. S.; Kerkstra, J. (Univ., Groningen, Netherlands). Stud. Biophys.; 29: 177-8(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

Localization of the serotonin-releasing effect of x irradiation was attempted in rabbits. The rabbits were exposed in the following areas: head, thorax plus liver and stomach; abdomen without liver and stomach; and circulating blood. Only irradiation of the abdominal region resulted in enhancement of the plasma serotonin level. (ERB)

15058 PHARMACOLOGICAL STUDIES ON CHEMICAL PROTECTORS AGAINST RADIATION. 6. BIOASSAY OF RADIOPROTECTORS BY CHANGE OF BODY WEIGHT OF X-IRRADIATED MICE. Shinoda, M. (Hoshi Coll. of Pharmacy, Tokyo); Shimizu, S.; Takagi, Y.; Akaboshi, S. Yakugaku Zasshi; 92: No. 4, 437-41(Apr 1972). (In Japanese).

Examinations were made on the effectiveness of radiation protective agents, using S-(2-aminoethyl)isothiuronium bromide hydrobromide (350 mg /kg), and 2-mercaptoethylamine (250 mg/kg), with decrease in body weight of mice by x-ray irradiation as an indicator. The effective method was found to be the use of ddY male mice as the experimental animal, with x-ray doses of 400 to 600 R, and measuring variations in body weight during and after irradiation, by which a significant protective effect was found against body weight decrease. (auth)

15059 POSTIRRADIATION TREATMENTS. Bacq, Z. M. J. Belge Radiol.; 55: No. 5, 557-562(1972).

A review of the literature on treatments for modifying the harmful effects of radiation is presented. A review of chemicals used in post-irradiation treatments includes discussions of diet, methionine, alkoxyglycerols, macroglobulins, and antibodies. The use of bone marrow grafts and cell replacement therapy is reviewed with regard to immune reactions and secondary diseases. The effects of nucleic acids, nucleotides, and related substances are discussed. The effects of DNA and RNA on bacteria, isolated mammalian and plant cells, and whole mammals are reviewed. (60 references) (HLW)

15060 MODIFICATIONS OF THE ACTION OF DRUGS IN MAMMALS AFTER IRRADIATION. Bacq, Z. M. J. Belge Radiol.; 55: No. 5, 563-565(1972).

A literature review of experiments on the alteration of the action of drugs following irradiation is presented. An increased sensitivity and prolonged effects of barbiturates were found in young rats following irradiation. It was found that radioinduced changes in the permeability of membranes modified the distribution of drugs and that the action of apomorphine, acetozolamide, barbiturates, amphetamine, and chlorpromazine was enhanced following irradiation. The action of cholinergic drugs was decreased following irradiation. Irradiation resulted in liberation in the interstitial fluid and plasma of enzymes which alter the structure of macromolecules. (27 references) (HLW)

15061 EFFECT OF X-IRRADIATION ON THE ENDOCRINE FUNCTION OF THE CANINE TESTIS. Shimizu, T.; Yamashita, K.; Sugihara, H.; Tsuchiyama, H. (Nagasaki Univ.). Tohoku J. Exp. Med.; 106: No. 2, 125-34(Feb 1972).

Observations were made in dogs to determine whether x irradiation affects the secretion of androgens in the testes, and their responses to exogenous gonadotropin. The secretory activity was under pentobarbital anesthesia, determined by measuring 17-oxosteroids in spermatic vein blood. The radiation with 200 or 2,000 R was applied only to the testes, but it failed to stimulate or significantly alter the secretion of 17-oxosteroids in a period of up to 4 hr after exposure. However, at 200 R an increased secretion of testicular 17-oxosteroids into the spermatic vein became evident within 1 to 6 days, whereas after 2,000 R it was observed within 13 days only in a few cases. During the post-irradiation period of 30 days, irradiated testes responded to pregnant mare serum in doses of 40 iu/kg by producing larger amounts of 17-oxosteroids than normal, the maximum response occurring within a few days following irradiation. In connection with these experiments, histochemical studies of enzyme were carried out on the activity of secondary alcohol dehydrogenase in the testicular tissue. At 200 R, the enzyme activity in the Leydig cell areas was increased considerably and attained the maximum in a few days after irradiation, and was then progressively reduced. (auth)

15062 DISTRIBUTION OF HAEMOPOIETIC COLONY-FORMING UNITS IN THE MOUSE FEMUR, AND ITS MODIFICATION BY X RAYS. Lord, B. I.; Hendry, J. H. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Brit. J. Radiol.; 45: No. 530, 110-115(Feb 1972).

A method of dividing mouse femoral bone marrow longitudinally into two groups of cells of varying magnitude is described. By assaying the hemopoietic colony-forming units (CFU) in two zones of the marrow, their distribution across the diameter of the femur was determined. It has been shown that the concentration of CFU increases from the longitudinal axis of the femur (20 CFU per 10^5 bone marrow cells) towards the internal surface of the bone (45 CFU per 10^5 bone marrow cells) obeying approximately a square law relationship. Relatively few CFU remained in the periosteum or the bone matrix. Using x- and γ-ray CFU survival data, the effects of radiation on the location of CFU in the bone marrow were determined. The implications of the modified CFU distribution with respect to some experimental situations are discussed. (auth)

15063 RADIOPROTECTIVE EFFECT OF GLUTATHIONE ON MOUSE INTESTINAL DEATH. Urano, M.; Tanaka, N.; Eto, T. (Kyoto Prefectural Univ. of Medicine). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 3, 234-6(Jun 1972). (In Japanese).

The radioprotective effect of γ-L-glutamyl-L-cysteinylglycine (glutathione) was studied in vivo. Experimental animals were 8-week-old ICR/JCL male mice. Intraperitoneal administration of the agent was followed by whole-body irradiation of animals 30 min later. Animal death was observed every day and according to animal death frequency on the 4th post-irradiation day, the $LD_{50/4}$ was calculated by logit analysis. $LD_{50/4}$ of animals that received 0, 1.5, and 3.0 mg/g of glutathione were 843, 923, and 1067 rads, respectively. Protective effect of the agent was observed markedly when 3.0 mg/g of the drug was administered intraperitoneally 30 min before the whole-body irradiation. (auth)

15064 CRITICAL PERIOD OF MALFORMATION OF DIGITS IN MOUSE FETUS CAUSED BY GAMMA-RAY IRRADIATION DURING PREGNANCY. Ueda, K.; Yoshizawa, Y. (Tokyo Univ.).

Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 8, 964-70(Nov 1971). (In Japanese).

Detailed information about the critical period of digital malformations was obtained. The experimental animals used were mice of ddY strain, 70 days old. After keeping for a week, the estrus mice were kept in cages with males overnight and next morning those found with vaginal plugs were considered to be day zero of pregnancy. The pregnant mice were exposed to the gamma rays of cesium-137. Total exposure dose was 200 R, and dose rate 3.3 R/min. The mice were divided according to starting time of irradiation into five groups. Irradiation started at 4:00 a.m., 9:00 a.m., 2:00 p.m., 7:00 p.m., and 0:00 a.m. on the 11th day of pregnancy, and continued for one hour. On the 18th day of pregnancy, the fetuses were removed from sacrificed mothers, and digital malformations (ectrodactylism, brachydactylism, polydactylism, and syndactylism) and body weight were observed. The critical period for the digital malformations was found to be at 9:00 a.m. on the 11th day of pregnancy. The time was estimated at about 273 hours after mating. The appearance rate of the digital malformations reached to about 100% by exposure to 200 R. The critical period of the abnormal development of fore limbs appeared earlier than hind limbs and continued longer. (auth)

15065 EFFECTS OF TOTAL EXPOSURE TO ^{60}Co GAMMA RADIATION ON CEREBRAL ENERGY PRODUCING AND TRANSFERRING SYSTEMS. Pausescu, E.; Paun, C.; Chirvasie, R.; Teodosiu, T. (Fundeni Clinical Hospital, Bucharest). Strahlentherapie; 144: No. 3, 370-376(Sep 1972).

The changes in the distribution of the components of the AMP-ATP system and in the activity of some related enzymes were studied in the cerebral nuclear, mitochondrial, and cytoplasmic subcellular fractions in dogs, 24 hours after whole-body exposure to cobalt-60 gamma-radiation at two different doses (300 and 600 rd, respectively). From the statistical and correlative analysis of the experimental data it was concluded that this radiation develops depressive effects on the cerebral stores of high energy phosphates of adenosine and on the activities of the related enzymes, these effects are essentially connected with the radiation dose, among these phosphates, ATP is the critical target for gamma-radiation, an uncoupling of oxidative phosphorylation seems to be responsible for the radiation-induced depression of ATP content in the brain subcellular fractions and likewise, a breakdown of the components of this system appears to occur in this instance. The results provide suggestions for effective methods of radio-protection. (auth)

15066 STUDY OF THE GASTROINTESTINAL IRRADIATION SYNDROME IN PIGS. Daburon, F.; Remy, J.; Nizza, P. (CEA, Jouy-en-Josas, France). Strahlentherapie; 144: No. 3, 343-361 (Sep 1972). (In French).

The gastrointestinal syndrome following γ-ray exposure (mean doses of 1600 rd at the sagittal level) was studied in 32 Pitman–Moore pigs from the points of view of clinical aspects, excretion of water and electrolytes (Na, K, Ca, Cl), and changes of some blood and urine constituents. Symptoms were different from those described in other laboratory animals, especially as regards survival (5 to 7 days), and electrolyte excretion. Finally death causes are discussed. (auth)

15067 EFFECT OF FRACTIONATED X-RAY IRRADIATION ON THE FERTILITY OF IN UTERO IRRADIATED MICE. Langendorff, H. M.; Neumann, G. K. (Heiligenberg-Institut, Ger.). Strahlentherapie; 144: No. 3, 324-337(Sep 1972). (In German).

P-maternal animals were irradiated on five successive days with 40, 60, or 80 R per day, during the blastogenesis, the first half of organogenesis, and the second half of organogenesis or the fetal period. In the maternal animals irradiated during the second half of organogenesis, the effect of an additional 20 R per day was tested, in the same way administered on five following days. The greatest influence of irradiation on frequency and quantity of litters and reproductive capacity of the F_1-animals was found in the group of animals irradiated within the fetal period between the 11th and 15th day after copulation. Animals irradiated with 60 or 80 R per day had no more descendants. The early mortality is greatest in the F_2-generation, whose parents had been irradiated with 40 R per day during this period. The number of litters per F_1-animal depends on the irradiation dose and the phase of gestation in which the P-maternal animals had been exposed. Up to the second half of organogenesis (11th until 15th day after copulation), the frequency of litters decreases in correlation to the progressive development of the embryos. In equal stages of development this effect of proportional decrease is noted with increasing dose. In the F_1-animals irradiated in the course of the fetal period (14th to 18th day after copulation), the influence on the frequency of litters is much less marked, but shows a strong dependence upon the dose. As the average quantity of litters, in contrast to their frequency, is much less influenced by fractionated irradiation, the differences in the reproductive capacity are related to the variability of the average frequency of litters. (auth)

15068 MECHANISM OF ACTION OF THE RADIOSENSITIZING SUBSTANCE SYNKAVIT: ESR STUDIES. Lohmann, W. (Technische Univ., Munich). Strahlentherapie; 144: No. 3, 319-323(Sep 1972).

Synkavit might exert its radiosensitizing effect by acting as an electron acceptor. Both the direct oxidation of the relevant site of a biomolecule and the influence upon its SH groups (indirect oxidation) by radiosensitizers are important to consider when the mechanism of action of radiosensitizing substances is studied. (auth)

15069 DYNAMICS OF IMMUNOCYTES FOLLOWING X-IRRADIATION. Ogino, K. (Yamaguchi Univ., Ube, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 4, 348-59(Jul 1972). (In Japanese).

The effects of x irradiation on the dynamics of the two types of immunocytes, large immature lymphocytes and plasma cells, were investigated in the present study. Male albino mice of CF #1 strain, about 2 months old and weighing about 30g, were used. These mice were injected intraperitoneally with 0.2 ml of typhoid-parathyphoid vaccine before or after a whole body x-irradiation with 500 R. They were divided into 7 groups as follows: non-treated normal mice, mice receiving antigen injection alone (AG), mice receiving x irradiation alone (R), mice receiving x irradiation on the 3rd day after antigen injection (AG-3D-R), mice receiving x irradiation on the 1st day after antigen injection (AG-1D-R), mice receiving x irradiation immediately after antigen injection (AG-R), and mice receiving x irradiation 1 day before antigen injection (R-1D-AG). In the AG group, a marked increase in numbers of large immature lymphocytes and plasma cells was observed. This suggests that the cellular proliferation response following stimulation by antigen consists of two phases. The first phase was radiosensitive and the second phase was unaffected by x irradiation. Thus, the first phase can be also called the lymphocyte phase and the second one the plasma cell phase from the view of radiosensitivity. In the AG-3D-R group the plasma cell reaction was definitely delayed. The similar sequence occurred in the AG-1D-R and Ag-R groups. This suggests x irradiation after antigen injection may delay the plasma cell reaction in the primary immune response. The plasma cell reaction was found to be somewhat enhanced in the R-1D-AG group that received x irradiation prior to antigen injection. (auth)

15070 PROLIFERATIVE ACTIVITY OF BONE MARROW CELLS OF DOGS EXPOSED TO CHRONIC AND REPEATED ACUTE GAMMA-IRRADIATIONS. Zukhbaya, T. M. Kosm. Biol. Med.; 7: No. 1, 34-36(1973). (In Russian).

The proliferative activity of bone marrow cells of dogs exposed to a 3 yr chronic gamma irradiation (the dose rate of 63 rads/year) in combination with repeated acute irradiations (at a dose of 42 rads/20 hr each) was examined. The total mid-tissue dose was 570 rads. The proliferative activity of erythroblasts remained undisturbed. Leukoblasts showed an inhibition of regenerative processes. At the end of the experiment an increased mitotic activity of myeloid elements was observed together with a significant decline of the number of myeloid cells in bone marrow and a decrease of leukocytes in the peripheral blood. (auth)

15071 MORPHOLOGICAL CHANGES OF DOG LIVER DURING CHRONIC GAMMA-IRRADIATION. Savina, E. A.; Podymov, V. K.; Plakhuta-Plakutina, G. I.; Yakovleva, V. I.; Markelov, B. A. Kosm. Biol. Med.; 7: No. 1, 29-34(1973). (In Russian).

Thirty dogs were exposed to chronic (with doses of 21, 62.5 and 125 rads/year) and combined (chronic exposure at a dose of 62.5 rads/year and acute exposure at doses of 58 and 126 rads/year) gamma irradiation during three years. Morphological changes in the liver of the dogs were followed using 210 liver biopsies (150 experimental and 60 control). The changes developed in relation to the duration and pattern of irradiation. The chronic exposure at doses of 21 and 62.5 rads/year induced no structural or histochemical changes in the liver. The combined exposure brought about hydropic and protein dystrophy. The greatest dystrophic abnormalities occurred in response to a total dose of 565.5 rads when dosages of acute exposure were twice as high as those of chronic irradiation. (auth)

15072 EFFECT OF CHRONIC IRRADIATION OF DOGS WITH ^{60}Co GAMMA-RAYS ON THE LEVEL OF AUTOANTIBODIES. Zueva, V. A. Kosm. Biol. Med.; 7: No. 1, 25-29 (1973). (In Russian).

Dogs were exposed to chronic irradiation with ^{60}Co gamma rays during 2.5 years at doses of 25 rem (1st group) and 150 rem (2nd group) and to a combined irradiation at a dose of 75 rem per

year supplemented with short-term exposures at a dose of 50 rem three times a year (3rd group). The chronic irradiation of dogs of the 2nd and 3rd groups induced the following changes in the immunobiologic reactivity: an increase of titers of incomplete and complement-fixing autoantibodies. The dogs of the 1st group showed no differences in these indices as compared to the controls. (auth)

15073 SEARCH FOR RADIOPROTECTIVE COMPOUNDS IN THIOGLUCOSIDE DERIVATIVES. Ishiguro, S. (Kyorin Pharmaceutical Co. Ltd., Tokyo); Sekiya, M.; Arai, Y.; Tanooka, H. Chem. Pharm. Bull. (Tokyo); 20: No. 6, 1332-4(Jun 1972).

Test compounds were acetylated (1-thio-β-d-glucopyranose and 1-thio-β-d-glucopyranosides (known compounds)) and acetylated (1-thio-β-d-glucopyranosides (new compounds)). They are derivatives of 1-thioglucosides having a different chain length between the phenyl and sugar moieties. Each compound was dissolved in saline and injected intraperitoneally into mice (500mg compounds per kg of female mice of the ICR strain, age 8 weeks). Thirty minutes after injection, the animals were subjected to whole-body irradiation with 700 rad x rays. The survival rate of mice was observed for 30 days after irradiation. It seemed that the best enhancement of survival was by phenethyl in the aglycone group that possessed a longer alkyl chain than others between the two functional groups, i.e., the sugar and benzene moieties, among the tested compounds. Introduction of an amino group to the benzene skeleton (o-methanesulfonamidophenyl) did not improve the protective action of phenethyl, as well as introduction of a chlorine (o-chlorobenzyl and p-chlorobenzyl). Further extension of the alkyl chain (o-phenylpropyl) did not increase the protective effect. It was found that there was little possibility of obtaining a high dose-modification factor by any of the tested compounds. The presence of radical scavengers such as a mercapto group might be essential in the compounds to obtain the potent protective action. It is, however, possible to extend the chain length between the two functional groups further, and the effect of this chain extension is now under investigation. (auth)

15074 ACUTE DEATH OF MICE FROM MASSIVE DOSES OF HIGH ENERGY ELECTRONS. Takeshita, Kenji (Hiroshima Univ.). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 9, 1048-1053(Dec 1971).

The acute effects of massive doses of 25-MeV electrons produced by a 35-MeV linear accelerator on mice were studied. The maximum dose rate was 130 krad/sec, and the time until death during irradiation was 2.6 sec. Mice died following an exposure of at least 170 pulses. Timing of acute death was delayed following administration of phenobarbital. The mean survival times of mice after irradiation by 6 to 26 pulses were in the range of gastrointestinal death. (auth)

15075 EXPERIMENTAL STUDY ON THE EFFECT OF IONIZING RADIATION ON THE WATER CONTENT OF THE BRAIN. Suzuki, Toshihiko (Iwate Medical Coll., Morioka, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 32: No. 1, 63-72(Apr 1972). (In Japanese).

The heads of mice (ddN strain) were irradiated with a single dose of x rays in doses of 1000R, 3000R, and 5000R while protecting the rest of the body with an adequate shield. Changes in the water content of the brain tissues were examined by the cobaltous chloride method from ½ to 72 hours after irradiation, and the histological changes were also examined microscopically. Measurements of the bound water indicated an immediate decrease after irradiation in each irradiated group, and no recovery was apparent during the initial 72 hours. Free water showed a temporary increase 24 hours after irradiation in the groups irradiated with 1000R and 3000R, but the group irradiated with 5000R did not show an increase. Changes observed in bound water represented a physicochemical change due to the ionizing radiation and the free water was interpreted as edema caused by a biological reaction. Microscopic studies on the histological changes revealed dilatation of the perivascular space and vacuolar changes of the ground substance. The severity of these reactions was directly proportional to the dose of irradiation. Changes were very slight in the group irradiated with 1000R. Changes were noted in the other groups three hours after irradiation, while no apparent changes were observed immediately after irradiation. A decrease in bound water preceded the histological changes in the brain tissue with x-ray irradiation. (auth)

15076 PROTECTIVE EFFECT OF CYSTAMINE ON X-RAY INDUCED DAMAGES IN GERM CELLS OF MALE MICE. Gugushvili, B. S.; Pomerantseva, M. D.; Vilkina, G. A. (Inst. of General Genetics, Moscow). Genetika; 8: No. 10, 42-49(Oct 1972). (In Russian).

Male mice from CBA strain were injected peritoneally with cystamine (150 mg/kg) or distilled water for 10 to 15 min. before irradiation (400 R). The rate of x-ray induced dominant lethal mutations was significantly lower in germ cells (spermatozoa, spermatids, spermatocytes) of cystamine-treated mice. The mean protection coefficient was 0.8. Cystamine decreased the induced death rate of embryos after the implantation more than before the implantation. Cystamine did not affect the rate of induced reciprocal translocations in spermatogonia. (auth)

15077 LUMINESCENT CYTOCHEMICAL INVESTIGATION OF PROTEINS OF THE CORTEX OF THE SUPRARENAL GLAND AFTER THE ACTION OF IONIZING RADIATION. Khamidov, D. Kh.; Khakimov, P. A.; Mamataliev, U. (Inst. of Biochemistry, Kiev). Dokl. Akad. Nauk Uzb. SSR; No. 7, 58-60(1972). (In Russian).

The protein content of the suprarenal glands of white rats was studied by cytofluorometry of cortex cells during early and later periods following irradiation with ^{60}Co in doses of 50 to 1,200 R. Irradiation caused a maximum increase in quantity of protein (37% higher than that of the controls) after a dose of 200 R and at a period of one hour after irradiation. (KSW)

15078 NUMERICAL CHANGES OF GOMORI POSITIVE GLIA UNDER VARIOUS EXPERIMENTAL CONDITIONS. I. THE EFFECT OF X-IRRADIATION. Srebro, Z.; Rzehak, K. (Inst. of Biomorphology, Krakow). Folia Biol. (Krakow); 20: No. 4, 369-382(1972).

Irradiation of the head of adult rats causes a significant increase in the number of periventricular glial cells showing chrome haematoxylin positive granulations. This numerical increase is evident at day 7 post-irradiation, being even more pronounced at day 14. A tendency to return to normal levels is observed at day 21 post-irradiation. Sex differences exist as regards the extent and mode of the reaction of the Gomori positive glia to the irradiation. The results are discussed in view of recent data indicating an important biological role of the Gomori positive glia as part of a basic brain protective mechanism. (auth)

15079 EFFECT OF IMMUNOSUPPRESSION ON ONCOGENESIS BY MURINE SARCOMA VIRUS. Zisblatt, Martin; Lilly, Frank (Albert Einstein Coll. of Medicine, Bronx, NY). Proc. Soc. Exp. Biol. Med.; 141: No. 3, 1036-1040(Dec 1972).

In adult mice the incidence and mean latency periods of tumors appearing after infection with MSV were dependent upon the dose of virus inoculated and the immunological state of the host. Animals of reduced immunological competence had a tenfold higher susceptibility to tumor induction as well as a decreased latency period to tumor appearance compared with controls. Whereas the tumors regressed in intact mice, they tended to grow progressively in immunosuppressed hosts. X irradiation of the host prior to infection increased the susceptibility to both induction and progressive growth of the tumor. Animals inoculated 1 wk after irradiation demonstrated an increased ability to resist progressive tumor growth by comparison with those inoculated 1 day after irradiation, and virus inoculations occurring 3 wk after irradiation produced few progressively growing tumors. (HLW)

15080 RADIOSENSITIVITY OF CAPILLARY ENDOTHELIUM. Reinhold, H. S.: Buisman, G. H. (Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk). Brit. J. Radiol.; 46: No. 541, 54-57(Jan 1973).

Starting with a subcutaneous air pouch in the rat, a system was developed in which a thin sheet of connecting tissue was partially separated from its surroundings. In a small area that was depleted of blood vessels by freezing, vascular proliferation was induced by the application of a stimulus employing uric acid and lithium lactate. In unirradiated preparations, the depleted area became increasingly re-vascularized in 12 days, while in the irradiated preparations there was a paucity of vessels, the degree of reduction depending on the dose of radiation. As a quantitative indication of the vascular index the local amount of an intravenously injected tracer was determined. The tracer substance was a fluorescent dye, and quantification was performed by means of a microfluorometer. The vascular index, as measured by means of microfluorometry, was probably closest to the vascular silhouette. The survival curve derived in this way showed a D_0 value of about 170 rads, a N value of about 7, and a DQ of about 340 rads. Split-dose experiments with an initial dose of 500 rads, followed after 24 hours by a test-dose, showed a (D_2-D_1) value of about 290 rads. In contrast to earlier observations, these results indicated that the radiosensitivity of the endothelial cells of capillaries is of the same order of magnitude as that of epithelial cells and cells of supporting tissues. (auth)

15081 CHANGES IN THE SERUM AND URINARY ACTIVITY OF PEPSIN IN ANIMALS EXPOSED TO WHOLE-BODY X IRRADIATION. Vranovska, J.; Pospisil, J.; Dienstbier, Z. (Charles

Univ., Prague). Cas. Lek. Cesk.; 111: No. 10, 216-18(3 Mar 1972). (In Czech).

In rats exposed to whole-body x irradiation with 800 and 200 rads and in dogs irradiated with 600 rads, a reduced activity of serum pepsin was found during the first 24 hrs after irradiation. In rats exposed to a whole-body dose of 800 and 200 rads, the lowest values were found after 24 hrs, in dogs after 3 and 6 hrs following whole-body irradiation. These findings were in agreement when both heteroproteolytic and autoproteolytic methods were used. (NSA of Czech.)

15082 EFFECTS OF THE JRR-1 IRRADIATION ON REPRODUCTIVE FUNCTION OF THE MOUSE. 3. RESULTS ON REPRODUCTIVE ABILITY OF DESCENDANT FROM IRRADIATED MALE MOUSE. Tanaka, R.; Kashiwabara, T. (Ibaraki Univ., Ami, Japan). Nippon Chikusan Gakkai-Ho; 43: No. 2, 62-8(Feb 1972). (In Japanese).

The purpose of this investigation was to observe the reproductive function of offspring from irradiated male and normal female mice. F_1 offspring were obtained from the male mouse irradiated with JRR-1 reactor for 1 hour and the normal female mice changed every 10 to 15 days. Descendants of the F_1 offspring were produced by full-sib mating of the primiparous litter. The data obtained were classified into three periods according to date of conception of the F_1: the 1st group was 1st to 25th day; the 2nd group was 26th to 60th day; and the 3rd group was 61st to 120th day after the irradiation. The results obtained were as follows: a recessive lethal gene was induced; induction of recessive semi-lethal gene was deduced; no variation in sex ratio; premature death seemed to be induced by the recessive semi-lethal gene; increase of sterile females; age in days at the time of primiparity was retarded according to lapse of generation; rate of growth was delayed in successive generations; the 1st group was exterminated at F_5 generation, the 2nd group at F_4, and the 3rd group at F_7; morphological abnormalities were short-ear and hypoplasia of testis. (auth) (Japan)

15083 IRRADIATION OF NONINCUBATED DUCK BLASTODERMS WITH X-RAYS. STUDY OF THE GERMINAL LINE IN EMBRYOS AT DIFFERENT PERIODS FROM THE PRIMITIVE LINE UP TO THE 14 SOMITE PAIR LINE. Fargeix, N. (Univ., Clermont-Ferrand, France). Compt. Rend., Ser. D; 275: No. 9, 1011-1014(28 Aug 1972). (In French).

Duck embryos having developed from x-ray irradiated non-incubated blastoderms present the same number of germ cells as normal embryos up until the six-somite-pair stage. After this stage the number of germ cells diminishes progressively in the irradiated specimens while increasing in normal specimens. (France)

15084 MORTALITY IN RAT-MOUSE RADIATION CHIMERAS. Mitchell, T. J.; Congdon, C. C.; Toya, R. E.; Kastenbaum, M. A.; Gardner, D. A. (Oak Ridge National Lab., TN). Rev. Eur. Etud. Clin. Biol.; 17: No. 8, 782-787(1972).

Ninety-day mortality from secondary disease in lethally irradiated mice receiving transplanted rat bone marrow was dependent on the dose of cells transfused intravenously. With the highest cell doses (78 and 98×10^6) the final mortality was about 24 percent; at the lowest cell doses (26 and 32×10^6) it was approximately 42 percent. In the initial analysis of these experiments, on the other hand, age of the rat donor was not a significant independent variable. In comparing two replicate experiments there was a significant variation in mortality results that could be removed by eliminating from the calculations all mice that died before day 15 after irradiation. With these mice left out, a broad region of low mortality (16 percent) at 90 days could be defined, dependent on the higher cell doses but spread over a wide region of donor animal ages. Outside of this "low mortality region" a high mortality region remained in the treatment variables factor space, with a final cumulative mortality of about 43 percent. Some of the mice surviving 90 days showed complete loss of the rat marrow transplant, but there was no difference between the regions of low and high mortality. When partial loss of transplant (which also was noted) was included, reversions were greatest in the region of high mortality. (auth)

15085 F-FACTOR OF THE SPLEEN-COLONY ASSAY FOR HEMOPOIETIC STEM CELLS. Till, J. E. (Ontario Cancer Inst., Toronto); McCulloch, E. A. Ser. Haematol.; 5: No. 2, 15-21 (1972).

Irradiated and unirradiated recipient mice of genotype W/W^v were used to test for an effect of increasing radiation dose to the recipient on the number of colonies formed in the spleen-colony assay. The colony count per spleen remained constant for doses to the recipient between 0 and 500 rads per mouse. Between 500 and 850 rads per mouse, a slight increase in colony number per spleen was observed. The results obtained indicate that post-irradiation shrinkage of the spleen does not reduce the "f-factor" for normal adult marrow cells assayed for their content of colony-forming units by intravenous injection into recipient mice within 2 hours after irradiation. If this result, obtained with mice of genotype W/W^v, is also applicable to mice of normal genotype, then some of the data in the literature should be reinterpreted. When this is done, a value of 0.20 to 0.25 is obtained for the f-factor for intravenously injected normal adult mouse marrow cells. (auth)

15086 EFFECT OF LUNAR SOIL ON RADIATION INJURIES IN MICE. Antipov, V. V.; Davydov, B. I.; Gaidamakin, N. A.; (and others). Cosmic Res. (USSR) (Engl. Transl.); 10: No. 3, 394-402(1972).

Translated from Kosm. Issled.; 10: No. 3, 439-49(1972).

The fine fraction of lunar soil from the Sea of Fertility was administered to mice before irradiation by three routes: by inhalation, through the esophagus, or intraperitoneally. Administration of this substance caused no significant change in the mortality rate of the animals and did not affect the response of the peripheral blood to radiation. In mice receiving lunar soil by inhalation or by intraperitoneal injection before irradiation the rate of increase in body weight was reduced. In 20 animals neoplasms were found at the 8th month of observation, and 16 of them had been in contact in some way or other with lunar soil. (auth)

Invertebrates

Refer also to abstract 15017.

15087 MATERNAL EFFECTS ON MUTATION INDUCTION OBSERVED AFTER X-IRRADIATION OF MATURE SPERM. Wuergler, F. E. (Swiss Federal Inst. of Tech., Zurich). Stud. Biophys.; 29: 131-6(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The absence of dose fractionation effects in x-irradiated mature sperm indicates that processes leading to chromosome rearrangements are active only after the sperm has inseminated an egg. These processes may then depend upon factors present in the egg. In view of this, the effects of egg type (maternal effect) on the frequency of mutations obtained in uniformly x-irradiated Drosophila sperm were studied. (ERB)

15088 SENSITIVITY TO AN ACUTE GAMMA RADIATION EXPOSURE OF SUCCESSIVELY IRRADIATED GENERATIONS OF THE COWPEA WEEVIL. Hossain, M. M.; Brower, J. H.; Tilton, E. W. (Dept. of Agriculture, GA). J. Econ. Entomol.; 65: No. 6, 1566-8(Dec 1972).

Five populations of Callosobruchus maculatus (F.) were treated, respectively, with 0 (control), 0.5, 1, 2, or 4 krad of gamma radiation for 7 successive generations. Groups of 7th-generation adults were tested for resistance to acute irradiation by exposure to total doses of 16 and 50 krad. Unirradiated 8th-generation adults from each population were checked for mating success and fecundity. When longevity was checked after acute radiation exposures, no evidence of increased resistance to acute radiation exposures was found. Irradiated populations showed slight but not significant decreases in mean survival time. A reduction in fecundity in the irradiated populations indicated also a decrease in population fitness. Therefore, the possibility of development of radiation-resistant insect strains by accidental exposure of some insects to substerilizing dosages during commercial radiation disinfestation does not appear to be a problem. (auth)

15089 SEXUAL COMPETITIVENESS OF ^{60}Co-IRRADIATED TOBACCO BUDWORM. Wolfenbarger, D. A.; Guerra, A. A. (Dept. of Agriculture, Brownsville, TX). J. Econ. Entomol.; 65: No. 6, 1596-1600(Dec 1972).

When single male, Heliothis virescens (F.) were irradiated with 15, 22.5, or 30 krad of gamma irradiation and placed with one unirradiated male and one unirradiated female, the irradiated moths were fully competitive based on the percentage egg hatch. Similarly irradiated males exposed to a normal-type population (equal numbers of males and females) or to a population with more unirradiated females than unirradiated males were not fully competitive. These differences in measurements of competitiveness may be influenced by artifacts caused by the test of competitiveness employed. Males irradiated with a dose of 22.5 krad as adults were more competitive than males irradiated with the same dose as pupae when they were exposed to a normal-type population. However, reduction in competitiveness was not more than 32%, even when the pupae and adults were irradiated with

30 krad. Moths irradiated at 15 krad as pupae were more competitive than those similarly irradiated as adults. (auth)

15090 SENSITIVITY OF GRAIN MITE EGGS TO GAMMA RADIATION AS INFLUENCED BY DOSE RATE AND TREATMENT AGE. Brown, G. A.; Davis, R. (Dept. of Agriculture, GA) J. Econ. Entomol.; 65: No. 6, 1619-21(Dec 1972).

Tests were made to determine the influence of radiation dose rate and age at treatment on some effects of gamma radiation on the eggs of Acarus siro L. Eggs of 5 ages were irradiated with 3 krad of gamma radiation from a cobalt-60 source at dose rates of 6, 18, and 43 rad/sec. Variations in egg mortality and hatching time resulted from treating eggs at different ages. Eggs irradiated at 3 days were the most sensitive, having the longest mean hatch time and the greatest mortality. The influence of dose rate was not significant. However, a consistently lower egg hatch resulted after the 43 rad/sec treatments than after the other treatments. (auth)

15091 BIOLOGY AND FLIGHT ABILITY OF THE HOUSE FLY FOLLOWING IRRADIATION OF THE PUPAE. Shepard, M.; Noblet, R.; Hunter, P. E. (Univ. of Florida, Sanford). J. Econ. Entomol.; 65: No. 6, 1721-5(Dec 1972).

Musca domestica L. pupae were irradiated with gamma rays from a cobalt-60 source one day prior to emergence and observations were made on the biology and flight ability of emerged flies. Flies receiving 2000 R or above laid inviable eggs, and if irradiated with 7000 R they did not oviposit. There was an increase in mortality of the F_1 flies with increasing irradiation. Increasing the irradiation dose from 0 to 4500 R increased pupal mortality and decreased adult longevity. More males than females emerged at all doses. No statistically significant difference in flight ability occurred between irradiated and nonirradiated flies when flown on flight mills, although females of all groups usually performed better than males. Ten-day-old flies were poorer fliers than 2- and 5-day-old individuals. Irradiated 2- and 5-day-old males tended to fly longer but slower than nonirradiated males; irradiated females at these ages tended to fly for shorter periods than nonirradiated females. Recapture of marked female flies on flypaper inside a greenhouse decreased with increasing irradiation. An electronic strobotac revealed a lower average wing-beat frequency with flies irradiated at 7000 R. At this dose level, flight activity was reduced in irradiated male flies 2, 5, and 10 days of age. (auth)

15092 GENETIC CONTROL OF INSECT POPULATIONS. Smith, R. H. (Oak Ridge National Lab., TN); von Borstel, R. C. Science; 178: No. 4066, 1164-74(15 Dec 1972).

A review is presented of genetic mechanisms that can be used alone or in combination for controlling the size of insect populations. The use of chromosome anomalies for regulating population size is discussed from the standpoint of radioinduced dominant lethality, the sterile male technique, and other mechanisms. Numerous studies on radioinduced mutations in Drosophila, Habrobracon, and other insects are reviewed. Methods for controlling populations by contrived dominant lethality, induced inherited sterility, contrived inherited partial sterility, recessive conditionally lethal mutations, and dominant conditionally lethal mutations are discussed. The development of mathematical models for kinetics of population collapse by the sterile male principle is reviewed. (HLW)

15093 ULTRASTRUCTURE OF SPERM IN F_1 PROGENY OF IRRADIATED MALES OF THE MEDITERRANEAN FLOUR MOTH, ANAGASTA KUEHNIELLA. Riemann, J. G. (Department of Agriculture, Fargo, ND). Ann. Entomol. Soc. Amer.; 66: No. 1, 147-153(15 Jan 1973).

Following pair matings of normal Anagasta kuehniella (Zeller) females to males, the male parents of which had received 15 krad of gamma radiation, a study was made of the ultrastructure of sperm in 10 pairs. Emphasis was placed on the spermathecae and seminal vesicles, although some observations were made on the testes. Only 3 spermathecae contained eupyrene (nucleate) sperm. A few apyrene (anucleate) sperm were found in 4 other spermathecae. All intact sperm in the spermathecae appeared to have a normal morphology. Eupyrene sperm bundles were found in the seminal vesicles of 7 males. These bundles had reduced numbers of cells, and the cells presented a variety of abnormalities. The most normal sperm were found in the males mated to the females with eupyrene sperm in their spermathecae. Nine sets of seminal vesicles contained large quantities of apyrene cells, and normal-appearing bundles of apyrene cells were found in the testis of the 10th male. Thus, in the sample studied, there was severe impairment to eupyrene sperm production. Apparently only morphologically normal cells are maintained in the spermathecae. (auth)

15094 INVESTIGATION OF THE RATE OF DEVELOPMENT OF DROSOPHILA HETEROZYGOUS FOR X-RAY INDUCED MUTATIONS. Vorobtsova, I. E.; Yur'eva, N. A. (Central Research Inst. of Roentgenology and Radiology, Leningrad). Genetika; 8: No. 10, 50-54(Oct 1972). (In Russian).

The effect of x-ray induced mutations in the heterozygous condition on the rate of transition of Drosophila through certain successive stages of ontogenesis (hatching, pupation, and imago emergence) was studied. The progeny of the first generation of irradiated males was heterozygous for x-ray induced mutations. The progeny of the intact parents was used as the control. It was found that the percent of individuals showing delayed development was significantly higher among the progeny of irradiated males than in the control group of animals. The later the stage of development studied, the less pronounced was the effect of the delay. The number of delayed individuals in F_1 generation increased linearly with the increase in the dose of irradiation received by the males. (auth)

15095 STUDIES ON THE REACTION OF THE HOUSEFLY (MUSCA DOMESTICA L.) TO THE PRESENCE OF RADIATION OF GAMMA RAYS. Vasilev, I. B.; Luvchiev, V. I.; Ivanova, R. G. (Zoological Inst., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 9, 1269-1271(1972).

Flies were placed in insectaria containing plastic feeders with sugar solutions. The flies were fed three times a day and the process of feeding lasted 30 min. Gamma rays from a ^{137}Cs source were directed to the feeders of one insectarium. Irradiation was carried out during the feeding period only. After 3 to 4 min there was a decrease in the number of flies around the irradiated feeders. In one experiment the feeders were irradiated for 30 min prior to the feeding period; the behavior of these flies did not differ from that of controls. The sensitivity of the flies to radiation decreased with each successive feeding. (HLW)

15096 EFFECTS OF GAMMA RADIATION ON THE OVARIES OF DESERT LOCUST SCHISTOCERCA GREGARIA (FORSKAL). Huque, H.; Ashraf, J. (Ministry of Agriculture and Works, Karachi, Pakistan). Int. J. Appl. Radiat. Isotop.; 23: No. 12, 557-559(Dec 1972).

The females of desert locust Schistocerca gregaria (Forskal), were irradiated with different doses of gamma radiation to determine the effects on the ovaries. At the lower dose the ovaries showed slight variation from the normal and the ovariole sheath was radioresistant. At the higher dose the evidence of damage was more pronounced and 20 krad produced severe damage and necrosis of ovarian cells. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstracts 14754 and 15110.

15097 (CNEA-318) PREPARATION AND COMPARATIVE BIOLOGICAL STUDY OF 3-CHLOROMERCURI-2-METHOXYPROPYLUREA AND 3-ACETOMERCURI-2-METHOXYPROPYLUREA LABELED WITH RADIOMERCURY. Caro, R. A.; Chueco, C. A.; de Paoli, T.; Hager, A. A.; Marques, R.; Nicolini, J. O.; Radicella, R. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 17p. (In Spanish). Dep. NTIS (U. S. Sales Only).

The preparation of 3-chloromercuri-2-methoxypropylurea (CMMP) and 3-acetomercuri-2-methoxypropylurea (AMMP), labeled with ^{203}Hg was studied. We propose a method of preparation that allows the increase of the yield with a reduction of the operation time; furthermore, it was possible to increase the operative security of the whole process. On the other hand, the comparative study of the biological properties of both compounds shows that they are quite similar. However, AMMP is eliminated more rapidly from the animal organism than CMMP. This fact implies that the first compound should be considered as the radiopharmaceutical of choice for the study of renal function with diuretic radiomercurials, because the total dose received by the patient is markedly smaller than that received with CMMP. (auth)

15098 IRRADIATION OF THE SPLEEN BY THE INTRA-ARTERIAL ADMINISTRATION OF ^{90}Y MICROSPHERES IN PATIENTS WITH MALIGNANT LYMPHOMA. A PRELIMINARY REPORT. Ariel, I. M.; Padula, Guido (New York Medical Coll., NY). Cancer; 31: No. 1, 90-96(Jan 1973).

A technique is described whereby large doses of internal irradiation can be delivered to the spleen. The technique consists of passing a catheter via the femoral artery into the splenic artery and injecting approximately 100 mCi of ^{90}Y microspheres that deliver ±122,000 rads of β to a 150-g spleen. Spleen scans taken before and after the internal irradiation of the spleen presented presumptive evidence that a radiation splenic destruction was effected. There is a marked diminution and at times absence of

pick-up of radioactive chromium-labeled red cells by the spleen. A preliminary report of 13 patients suffering from malignant lymphoma treated by this technique is presented. (auth)

15099 STUDIES ON THE HEMATOLOGICAL CHANGES AFTER ADMINISTRATION OF THERAPEUTIC DOSES OF RADIOACTIVE IODINE. 2. CHANGES OF THE PERIPHERAL BLOOD AND BONE MARROW AFTER RADIOACTIVE IODINE THERAPY FOR HYPERTHYROIDISM. Nakayama, S. (Kyoto Univ.). Nippon Ketsueki Gakkai Zasshi; 33: No. 5, 578-97(Oct 1970). (In Japanese).

After oral administration of a therapeutic dose of ^{131}I, the neutrophil, lymphocyte, and thrombocyte counts decreased rapidly within a few hours, showing the lowest level on the 7th day with subsequent gradual rises. The neutrophil count returned to the initial level in two months, and thereafter showed slight rebound, while the lymphocyte count still remained below the initial level even 5 yrs later. There was no correlation between the bone marrow radiation dose and percent decreases of the neutrophil and lymphocyte counts on the 7th day. Red cell count, hemoglobin content, mean lobe count of neutrophil, area index of platelet, and activity of alkaline phosphatase of neutrophil ranged in most cases within the normal limits after the therapy. The bone marrow picture of the hyperthyroid patients demonstrated hypercellularity, marked relative lymphocytosis, and apparent maturation arrest of the myeloid series. These findings were normalized after ^{131}I therapy together with the amelioration of thyroid function. The frequency of mitotically connected nuclear abnormalities in the erythroid series, especially interzonal residual fiber, karyomere, and incomplete division, was found to increase as early as 2 to 5 days after administration of ^{131}I, and the former two remained high as late as 3 yrs. These abnormalities were considered to be directly attributable to ^{131}I irradiation. In a few cases, hypoplasia of the bone marrow was seen concomitant with the development of hypothyroidism after ^{131}I treatment. The findings noted in the bone marrow of hyperthyroid individuals seem to indicate a state of high sensitivity to radiation. Although hematological changes found after ^{131}I therapy do not directly bear upon development of leukemia, the possibility of higher susceptibility to radiation in some of such patients as with persistent lymphopenia and bone marrow hypoplasia with hypothyroidism must be given careful attention. (auth)

15100 VANDERBILT EXPERIENCE WITH ^{131}I TREATMENT FOR GRAVES' DISEASE. Douglas, J. G. (Vanderbilt Univ., Nashville). S. Med. J.; 66: No. 1, 92-94(Jan 1973).

A retrospective study of 94 patients treated at Vanderbilt University Hospital between 1955 and 1960 is presented in an attempt to determine whether our incidence of hypothyroidism parallels that of other centers using conventional doses of ^{131}I. (auth)

15101 CYTOGENETIC STUDIES ON LYMPHOCYTES OF NEONATES AFTER PLACENTAL SCANNING. Gallon, W. (Cancer Council of Western Australia, Perth); Woodliff, H. J. Med. J. Aust.; 2: No. 26, 1455-1457(23 Dec 1972).

The chromosomes of human lymphocytes collected from neonates whose mothers had received Indium-113m for placental scanning and cultured in vitro for 48 and 72 hours with phytohaemagglutinin (PHA) did not differ significantly from those of control cells. (auth)

Animals

15102 HISTOLOGICAL CHANGES IN THE LIVER CELLS OF CHICK EMBRYOS CAUSED BY ^{3}H-LABELED NUCLEIC ACID PRECURSORS. Unger, E. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Stud. Biophys.; 29: 199-202 (1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

The effects of incorporation of ^{3}H-labeled thymidine and uridine on liver cells were studied in chick embryos. Histological examination of the cells showed that both of the ^{3}H-labeled nucleosides produced morphological changes in embryonic tissues. (ERB)

15103 INFLUENCES OF EXPERIMENTAL BONE TUMOR INDUCED BY RADIOACTIVE PHOSPHORUS ON THE SERUM PROTEIN IN RATS. Hiki, Y. (Nihon Univ., Tokyo). Nichidai Igaku Zasshi; 31: No. 7, 619-30(Jul 1972). (In Japanese).

Experimental bone tumors were induced by injection of radioactive phosphorus once every three weeks into the abdominal cavity of each Wistar strain rat. About thirty weeks after the injection of radioactive phosphorus, the experimental bone tumor was induced in the metaphyseal region of the long bone of the rat. The histological findings of the experimental bone tumor were similar to those of human osteosarcoma, i.e., the formation of osteoid, mitosis, atypical nuclei, and pleomorphic cells. According to the electrophoretic patterns of the experimental osteosarcoma induced by the injection, there were initially a decrease of the alpha 3-globulin concentration, and then an increase of the alpha 2- and beta-globulin concentrations during growth of the tumor. From the above-mentioned facts, the investigation of the alpha 3-globulin concentration in particular might serve as one of the effective judging factors for the early diagnosis of osteosarcoma in man. (auth)

15104 GENETIC EFFECTS OF RADIOACTIVE ISOTOPES. I. DOMINANT LETHALS FROM ^{89}Sr OR ^{131}I IN RAT SPERMATOGONIA. Baev, I.; Bairakova, A.; Benova, D.; Vassilev, G. (Research Inst. of Radiology and Radiation Hygiene, Sofia). Strahlentherapie; 144: No. 3, 338-342(Sep 1972)

Dominant lethals induced in rat spermatogonia following intraperitoneal injection of strontium-89 (1 μCi/g) or iodine-131 (3.5 μCi/g) were investigated. No consistency in dominant lethality was revealed among offspring of males irradiated at various times before mating. Genetic damage from strontium-89 was found to be more pronounced. An attempt was made to estimate gonad doses from both radionuclides. (auth)

15105 MATERIALY PO TOKSIKOLOGII RADIOAKTIVNYKH VESHCHESTV. VYPUSK 8. IOD-131. (Toxicology of Radioactive Substances. Number 8. ^{131}I). Letavet, A. A. (ed.). Moscow; Meditsina (1972). 248p.

This book consists of 22 articles by different authors on the toxicology of ^{131}I. The internal radiation effects from ^{131}I on rats, with emphasis on the thyroid gland, and the combined effects of ^{131}I and external x irradiation on the growth rate, liver, blood, bone marrow, sex glands, and general morphology of rats are separately examined in a number of papers. Six papers deal with the combined action of small doses of ^{131}I and external γ irradiation on the mitotic activity of cells, the blood vessel, and the nervous systems, the reproductive function and morphology of the rat. The toxic effects of ^{131}I on embryos and other aspects of embryogenesis in connection with the radioisotope are discussed. (197 references) (KSW)

15106 PHARMACOLOGICAL STUDIES ON CHEMICAL PROTECTORS AGAINST RADIATION. 7. RADIATION PROTECTIVE ACTIVITIES OF AET AND ITS RELATED COMPOUNDS AGAINST X-IRRADIATION. Shinoda, M. (Hoshi Coll. of Pharmacy, Tokyo); Shimizu, S.; Hino, T.; Tamaoki, B. I.; Akaboshi, S. Yakugaku Zasshi; 92: No. 4, 442-8(Apr 1972). (In Japanese).

Toxicity and radiation protective activity were examined in x-irradiated mice for 29 substances including N- or N'-alkylated derivatives of S-2-aminoethylisothiuronium bromide hydrobromide (AET-type compounds); guanidinoethyl disulfide-type compounds (GED-type compounds) obtained from AET-type compounds by transguanylation and oxidation; and 2-aminothiazoline-type (2-AT-type) compounds obtained by cyclization and deammoniation of 2-AT-type compounds. N-Methyl-AET and N'-methyl-AET compounds showed the same potency as the AET compounds but other compounds of the AET type had much less effectiveness. Dialkylation of the N or N' position in AET compounds totally abolished the effect. AET and GED compounds showed about the same potency. 2-AT-type compounds generally had an effect, though weak. (auth)

15107 LONG TERM GENETIC EFFECTS OF ^{90}Sr IN MICE. Reddi, O. S. (Osmania Univ., Hyderabad, India). Indian J. Med. Res.; 59: No. 11, 1754-7(1971).

A dose of 25 μCi of ^{90}Sr injected intraperitoneally as ^{90}Sr chloride into 8 to 10 week-old male mice with body weight ranging from 18 to 25 g showed dominant lethality as evidenced by intrauterine deaths for a period of 10 to 40 weeks after treatment. This is as a consequence of irradiation of stem cells and spermatogonia. Autoradiographic studies indicate heavy concentrations of ^{90}Sr in testes which accounts for long range effects. (14 references) (Indian Sci. Abstr.)

Microorganisms

15108 INACTIVATION AND GENETIC EFFECTS IN E. COLI BY ^{3}H- AND ^{14}C-THYMIDINE. Zywietz, F.; Kuenkel, H. A.; Trams, A. (Univ., Hamburg). Stud. Biophys.; 29: 95-103(1971).

From 8th annual meeting of the European Society for Radiation Biology; Basko Polje, Yugoslavia (20 Sep 1971). See CONF-710975.

After incorporation of ^{3}H- and ^{14}C-labeled thymidine (dTR) in cells of E. coli B/r lethal and mutagenic effects were studied. The influence of the internal β irradiation associated with nuclear transmutation on the ability of cell proliferation and production of auxotrophic mutants was observed for 60 days for ^{3}H-dTR and for

1135 days in the case of 2-^{14}C-dTR. The killing efficiencies were determined to 1/714 for ^{3}H-dTR and to 1/51 for ^{14}C-dTR. The number of auxotrophic mutants increased linearly with the number of disintegrations/bacterium. The identification of the mutants led to mutation spectra, which appeared to be different after ^{3}H- and ^{14}C-dTR incorporation. (auth)

Nuclide Kinetics and Toxicology

Man

Refer also to abstract 14761.

15109 (CEA-CONF-2127) VARIABILITY OF ^{90}Sr BONE BURDENS. Garnier, A. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires); Lanzola, E. (Pavia Univ. (Italy). Istituto d'Igiene); Karhausen, L. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 28p. (CONF-720818-3). Dep. NTIS (U. S. Sales Only).

From 2nd international conference on strontium metabolism; Glasgow and Strontian, Scotland (16 Aug 1972).

Measurements of ^{90}Sr and stable calcium and strontium were carried out on human bone samples from various age groups collected in various areas of Italy from 1967 to 1970. Significant differences appeared between some areas, which can be explained both by local dietary habits resulting in the ingestion of widely different amounts of stable calcium and strontium and the ecological conditions of ^{90}Sr transport. Their respective roles are discussed. (auth)

15110 (CEA-R-4388) ESTIMATION OF ABSORBED DOSE RATES IN THE ENDOSTEUM AND BONE MARROW OF VERTEBRAE CONTAMINATED BY β^- EMITTING BONE SEEKERS, Le Grand, Jacques (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Nov 1972. 124p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Paris Univ. (France). Faculte des Sciences.

In the spongy bone, the source medium (emitting electrons) is made of the bone trabeculae, assumed to be uniformly contaminated, and the target medium made of the tissues contained in the medullary spaces. The physical data needed were first gathered and the biological data examined: the histograms of the frequencies of the trabecula and medullary space chord lengths in a sample of 47 individuals from 0 to 30 yrs of age. As regards bone trabeculae, the histograms were practically the same, whatever the individual's age; as to the medullary spaces, the histograms were distorted according to the individual's age. The techniques for data analysis, without any a priori assumption, allowed a classification of the histograms according to an order approaching the classification of individuals by age. For the medullary spaces, the model was fitted to the experimental data by random sorting. For each class of age, there were calculated: the probability for electron emissions as a function of the distance from a point target, the absorbed doserates in the endosteum and bone marrow for monoenergetic electrons with energy ranging from 0.05 to 2 MeV and for the spectra of ^{90}Sr, ^{90}Y, and ^{90}Sr–^{90}Y in equilibrium conditions. (auth)

15111 (CNEA-322) RADIOSTRONTIUM IN MAN AS A FUNCTION OF AGE. Beninson, D.; Migliori de Beninson, A.; Menossi, C.; Kramer, J. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina)). 1972. 39p. (In Spanish). Dep. NTIS (U. S. Sales Only).

Data are presented on the content of ^{90}Sr in man in Argentina during 1960 to 1970 following uptake through the diet from fallout. The ratio of ^{90}Sr to Ca was determined in bone samples from individuals of various age groups ranging from fetuses to adults. (CH)

15112 (FOA-4-4489) IMPORTANCE OF THE INTRACELLULAR DISTRIBUTION OF RADIONUCLIDES IN THE HUMAN BODY. PRELIMINARY DISCUSSION OF ^{90}Sr AND ^{55}Fe. Rydberg, B. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Mar 1972. 21p. (In Swedish). INIS.

Effects resulting from radionuclides in the chromosomes of human cells are discussed. A method for estimation of the increase in dose is described. How different parameters with various degrees of uncertainty influence the results are discussed. Preliminary calculations for ^{90}Sr and ^{55}Fe suggest that the increase of dose for ^{90}Sr is below 20% and for ^{55}Fe it is of a factor of 4 magnitudes. (Sweden)

15113 (GSF-K-34(Ed.2)) DETECTION OF INCORPORATED RADIOACTIVE SUBSTANCES IN MAN. Kiefer, H. (Gesellschaft fuer Strahlenforschung m.b.H., Neuherberg bei Munich (West Germany). Institut fuer Strahlenschutz). Nov 1971. 21p. (In German). INIS.

For measurements of radioisotope incorporation, the radioactivity in the body is measured. The dose can then be determined from these measured data, if necessary. There are two incorporation measurements: in-vivo measurement and excretion measurement. In-vivo measurements are made using a human whole-body counter or a partial-body counter. The measuring principle and types of devices for both ways are discussed. (GF)

15114 (WP-42) THOROTRAST: A BIBLIOGRAPHY OF ITS DIAGNOSTIC USE AND BIOLOGICAL EFFECTS. (International Atomic Energy Agency, Vienna (Austria)). 16 Mar 1964. 154p. (In several languages). Dep. NTIS (U. S. Sales Only).

A total of 1,352 references are presented to publications in the world literature prior to 1964 on the toxic effects of Thorotrast (ThO_2 containing ^{232}Th) on man following use as a contrast media for diagnostic radiography. Papers are included on various related topics such as the ^{232}Th decay products ^{224}Ra and ^{228}Ra; measurements of the internal radiation dose following the intravenous injection of Thorotrast; pathological changes, including carcinogenesis, following the injection of Thorotrast; and animal studies on the effects of large doses of Thorotrast. (CH)

Animals

15115 (COO—1339-49) ANIMAL METABOLIC STUDIES OF STRONTIUM AND CALCIUM WITH SPECIFIC REFERENCE TO FALLOUT RADIONUCLIDES. Final Progress Report, August 15, 1970—November 30, 1971. (Illinois Univ., Urbana. Dept. of Veterinary Physiology and Pharmacology). 1971. Contract AT(11-1)-1339. 66p. Dep. NTIS.

Studies were conducted on calcium kinetics during pregnancy and lactation in Jersey cows using ^{47}Ca and stable Ca, and Ca mobilizing ability was measured by EDTA infusion. The specific activity-time curves for each cow and each injection period were fitted to a two-component exponential model; graphs and tables are presented to show results. The radiocalcium kinetic data suggest that there was a dietary effect on the readily exchangeable calcium pool. Standard and miniature swine from birth to six months of age were used in studies on the effects of time on retention of single injections of ^{85}Sr. The two types of pigs retained ^{85}Sr differently when measured 200 days after administration and differences in retention patterns were related to the qualitatively dissimilar growth curves of the two types. Studies on the effect of time on distribution of injected ^{85}Sr in the skeleton of six-month-old swine showed that there was a rapid loss of ^{85}Sr between days 1 and 10 and less so between days 10 and 28. A review is presented of studies on whole-body retention of single injections of ^{85}Sr in swine and dogs as a function of age. (HLW)

15116 (COO-2003-9) ECOLOGICAL IMPLICATIONS OF FALLOUT RADIOACTIVITY ACCUMULATED BY ESTUARINE FISHES AND MOLLUSKS. Schelske, C. L. (Michigan Univ., Ann Arbor. Great Lakes Research Div.); Wolfe, D. A.; Hoss, D. E. (National Marine Fisheries Service, Beaufort, N. C. (USA). Center for Estuarine and Menhaden Research). [nd]. 41p. Dep. NTIS.

Fallout radioactivity accumulated by estuarine organisms near Beaufort, North Carolina, was measured from October 1963 to October 1966. Sixteen species of fish were analyzed for fallout radioactivity. These fish were separated into four groups based on the predominant radioisotopes accumulated in the environment. One group contained ^{137}Cs, another group ^{54}Mn, another group ^{137}Cs and ^{54}Mn, and a fourth group contained little or no measurable quantity of either radioisotope. Nektonic feeders comprised the group that contained ^{137}Cs and benthic feeders contained ^{54}Mn. The results of these measurements suggest that the radioactivity accumulated by mollusks and fish reflects different ecological niches. Seven radionuclides were identified in the soft parts of hard clams, Mercenaria mercenaria; marsh mussels, Modiolus demissus; American oyster, Crassostrea virginica; and bay scallops, Argopecten irradians. Clams, mussels and oysters accumulated relatively large amounts of ^{144}Ce and ^{106}Ru. The radioisotope present in greatest concentrations in oysters was ^{65}Zn and in bay scallops was ^{54}Mn. Laboratory experiments on the accumulation of ^{65}Zn and ^{54}Mn confirmed these results. (auth)

15117 SUSCEPTIBILITY OF TWO STRAINS OF SITOPHILUS GRANARIUS TO 1,2-DIBROMOETHANE. 2. STRAIN DIFFERENCE IN UPTAKE AND METABOLISM OF RADIOLABELED FUMIGANT. Ellis, C. R. (Univ. of Alberta, Edmonton). J. Econ. Entomol.; 65: No. 6, 1573-7(Dec 1972).

Uptake and metabolism of uniformly labeled ^{14}C 1,2-dibromoethane (EDB) was compared in a resistant (LWR) and a normal

(LWN) strain of Sitophilus granarius (L.). The LWR strain was selected previously for 67 generations for resistance to methyl bromide and was 1.9 times more resistant to EDB than the (LWN) strain. LWR insects had a slower rate of uptake and a faster rate of metabolism of radiolabeled EDB than LWN insects of the same weight. Vigor tolerance and true resistance of the granary weevil to EDB fumigation are discussed. (auth)

15118 FORMATION OF BIOLOGICALLY ACTIVE ^{125}I-PROLACTIN BY ENZYMATIC RADIOIODINATION. Frantz, W. L.; Turkington, R. W. (Univ. of Wisconsin, Madison). Endocrinology; 91: No. 6, 1545-8(Dec 1972).

A method is described for the preparation of ^{125}I-prolactin that is biologically active. Ovine prolactin was radioiodinated with lactoperoxidase to yield ^{125}I-prolactin that had SA of approximately 130 μCi/μg, and that retained 60% of the biological activity of the native hormone as determined by in vitro assay. Biological activity of the ^{125}I-prolactin prepared by this method was further demonstrated by hormone-specific, saturable binding to particles prepared from mammary gland but not from several other mouse organs. (auth)

15119 CONCENTRATED SOURCES OF ALPHA PARTICLES WITHIN THYROID GLANDS. Van Middlesworth, L. (Univ. of Tennessee, Memphis). Endocrinology; 91: No. 6, 1534-6(Dec 1972).

One to ten percent of normal bovine thyroids have been shown to contain radioactivity compatible with ^{226}Ra and/or ^{228}Th and their radioactive daughters. Radioautographs from thin slices of these thyroids showed concentrated, irregular, anisotropic bodies, 10 to 60 μ in longest dimension, intensely bombarding thyroidal cells with alpha particles. It was not proved that thyroid disease is caused by radium or thorium in thyroid glands but it is suggested that the natural incidence of some thyroid diseases may be caused by ^{226}Ra and/or ^{228}Th concentrated within the thyroid. (auth)

15120 ASSESSMENT OF ABSORBED DOSES OF ^{210}Po IN RABBITS BY HISTOAUTORADIOGRAPHIC TECHNIQUES. Parfenov, Yu. D.; Solovev, A. I. (Inst. of Biophysics, Moscow). Strahlentherapie; 144: No. 3, 362-369(Sep 1972).

Distribution of ^{210}Po and assessment of absorbed doses in the organs of rabbits was followed on 128 male animals for 30 days after single intravenous and intratracheal administrations of polonium nitrate (25 μCi per animal). Concentrations of ^{210}Po in the liver, kidneys, spleen, heart muscle, bone marrow and testes were measured by the histoautoradiographic method by counting α-tracks. Concentrations of ^{210}Po in the investigated tissues are higher by 2,1–3,7 times with intravenous than with intratracheal injection, in the spleen they are still higher (5,3 times, red pulp) and (9,9 times, follicles). The ratio of ^{210}Po concentrations at some areas of kidneys was: convoluted tubules/medullary layer–15,3–45,6 and 20,4 to 36,7; glomerules/medullary layer–4,8–12,4 and 4,6–7,9; in the spleen: red pulp/follicles 1,8–4,2 and 2,1–8,5 with intravenous and intratracheal injections respectively. Elimination rate of ^{210}Po is similar for both routes of injection and does not essentially differ from that observed by radiometric measurements. Assessment of absorbed doses in the organs for 30 days performed by histoautoradiographic and radiometric methods does not differ by more than 2 to 3 fold. (auth)

15121 BINDING OF ^{125}I-LABELED ANTI-IgG, RHEUMATOID FACTOR AND ANTI-C3 TO IMMUNE COMPLEXES ON THE SURFACE OF VIRUS-INFECTED CELLS. Hayashi, Kozaburo; Lodmell, Donald; Rosenthal, Joel; Notkins, A. L. (Lab. of Microbiology and Immunology, Bethesda, MD). J. Immunol.; 110: No. 1, 316-19(Jan 1973).

An indirect radioimmunoassay using ^{125}I-labeled antiviral antibody is described for detecting viral antigens and antiviral antibody. The method demonstrates that the rheumatoid factor and complement can bind to immune complexes on the surface of infected cells. (HLW)

15122 EFFECTIVENESS OF PENTACINE FOR REMOVAL OF INTRATRACHEALLY ADMINISTERED ^{147}Pm. Zhanadilov, Sh. (Inst. of Hygiene and Occupational Disease, Moscow). Gig. Tr. Prof. Zabol.; No. 1, 42-45(Jan 1973). (In Russian).

The effectiveness of diethylenetriaminepentaacetic acid (DTPA) as a complexing agent for radioactive promethium has previously beem demonstrated. The effectiveness of pentacine was studied (trisodium-calcium salt of DTPA) in the removal of ^{147}Pm from a rat following intratracheal administration of ^{147}Pm. The radioisotope was found chiefly in the lungs, liver, and skeleton. The use of pentacine within one hour after introduction of ^{147}Pm into the rat resulted in a significant decrease (80 to 99%) of the isotope in the liver and lungs as compared with the control animals. If the use of pentacine was delayed for 2 to 14 days, elimination of ^{147}Pm from the liver and lungs was accelerated. (KSW)

15123 RADIONUCLIDE UPTAKE BY SOME FRESHWATER HYDROBIONTS. Dushauskene–Duzh, N. P. F.; Marchyulenene, E. D. P.; Nyanishkene, V. B.; Shuliene, R. I.; Polikarpov, G. G. (Inst. of Botany, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. C; 3: No. 59, 201-212(1972). (In Russian).

During 1967 and 1968 it was found that the accumulation coefficients of ^{90}Sr and ^{210}Pb were the same in fishes and molluscs, while that of ^{210}Pb in plants was an order lower than that of ^{90}Sr. The accumulation coefficients of ^{90}Sr and ^{210}Pb depended on the ash content of the aquatic organisms. ^{90}Sr, ^{144}Ce, ^{137}Cs, and ^{106}Pu accumulate in phytoplankton and silt with maximum coefficients. Among the radionuclides, ^{144}Ce exhibited the highest accumulation coefficient in aquatic organisms, while the coefficients of ^{137}Cs and ^{90}Sr were relatively low. Silt protected chironomid larvae against the absorption of ^{137}Cs, ^{144}Ce, and ^{106}Ru. The larvae accumulated the following radionuclides from contaminated food: ^{90}Sr, 10%; ^{137}Cs, 9%; ^{144}Ce, 11%; and ^{106}Ru, 6%. Carps assimilated 10% of the total ^{144}Ce ingested with chironomid larvae. The same degree of ^{210}Pb and ^{90}Sr accumulation occurred in fishes of different trophic levels. (HLW)

15124 DEVELOPMENT OF PLANKTONIC ORGANISMS OF AN EUTROPHIC RESERVOIR AND THEIR INTERACTION WITH RADIOACTIVE ENVIRONMENT. Yankyavichyus, K. K.; Antaninene, A. S.; Baranauskene, A. Yu.; (and others) (Inst. of Botany, Vilnyus, USSR). Liet. TSR Mokslu Akad. Darbai, Ser. C; 3: No. 59, 3-22(1972). (In Russian).

The potential capacity of planktonic organisms to accumulate a number of radionuclides was studied under experimental conditions in a reservoir of an eutrophic type, in the Lagoon of Kursiu Marios. In 1970 the hydrochemical conditions in the Lagoon area near Juodkrante were favorable. The following species of planktonic algae were found to be predominant: Aphanizomenon flos-aquae, Coelosphaerium kuetzingianum, Gomphosphaeria naegelianum, Oocystis lacustris, Pediastrum boryanum, Scenedesmus quadricauda. The maximum biomass of planktonic algae was observed to be in the last ten days of August; the minimum biomass was in the middle of July. In summer the lack of N in the water appeared to be a limiting factor for the development of some phytoplankton species. Bacterial counts in the water were found to be 825 to 9576 thousand cells/ml, while that in the bottom was 10 to 100 times higher. Fourteen bacterial species, belonging to the genera Bacillus, Bacterium, Pseudomonas, Micrococcus, Sarcina and Planosarcina, have been determined. A considerable amount of protein mineralizing bacteria as well as aerobic and anaerobic bacteria was observed in the Lagoon water and bottom, while the bacteria assimilating mineral forms of N, denitrifying bacteria, aerobic and anaerobic N fixatives were found to be less numerous. Significant fluctuations of proteinase, cellulase, amylase, and pectinase were determined. The maximum ferment accumulation in the water was observed to be at the end of July (the 1st maximum) and at the end of August (the 2nd maximum). In summer 1340 to 11575 mg of aquatic organic substance are mineralized by bacteria in the course of 24 hours. Thus, 100 to 873 mg/m^3 of N and 6 to 55 mg/m^3 of P are regenerated from the decomposed organic substance. The maximum zooplankton biomass, which is considered to be a consumer of phyto- and bacterioplankton, was determined at the end of July and at the beginning of August. Quantitative determinations of soluble (in water) proteins showed their fluctuation to be 0.002 to 0.1 mg/l. They were immediately decomposed to amino acids and took part in the biological turnover. Among free amino acids α-alanine, glutamic and aspartic acids were predominant. The most intensive accumulation of ^{90}Sr, ^{137}Cs, ^{144}Ce, and ^{106}Ru took place during the first hours of its exposure to radioactive water. Cerium-144 was found to have a particularly high accumulation coefficient. Unequal accumulation coefficient of radionuclides by plankton was observed to exist throughout the season. Radionuclides are fixed by plankton rather firmly. (auth)

15125 BINDING OF ^{85}Sr TO HOMOGENATE AND SUBCELLULAR FRACTIONS OF RABBIT TISSUES. Rosenthal, H. L.; Cochran, O. A. (Washington Univ., St. Louis). Proc. Soc. Exp. Biol. Med.; 141: No. 3, 850-856(Dec 1972).

Tissue samples from the liver, kidneys, ovaries, and testes of rabbits were homogenized and chlorides of magnesium, calcium, strontium, and barium were added to appropriate buffers for binding studies. Equilibrium dialysis was performed with tissue preparations in cellulose bags; the bags were placed in tubes containing buffer with ^{85}Sr added. After dialysis, aliquots of the bags and external solutions were counted for ^{85}Sr activity in a scintillation detector. Results of dialysis experiments showed that the RNA, DNA, and protein content of homogenates was significantly lower following dialysis, suggesting the loss of dialyzable nitrogen-containing tissue constituents. The binding of ^{85}Sr to all tissue homogenates and subcellular fractions (nuclei, mitochondria, microsomes, cell sap) was linear for all concen-

trations up to 20 μg/liter. Results demonstrate that strontium nuclides are bound to testicular and ovarian tissues more than to liver and kidney tissues. (HLW)

15126 SINGLE INJECTION CLEARANCE OF ^{131}I-HIPPURAN. A COMPARISON WITH PARA-AMINO-HIPPURIC ACID CLEARANCE AND AN ATTEMPT AT CLEARANCE DETERMINATION BY EXTERNAL MONITORING IN CONNECTION WITH ISOTOPE RENOGRAPHY. Broens, M. (Odense Sygehus, Denmark). Dan. Med. Bull.; 19: No. 5, 148-153(1972).

Radioisotopes employed in studies on renal physiology make it possible to determine the plasma clearance of a substance more rapidly and accurately after a single administration. A method is described for determining the clearance of ^{131}I-hippuran following a single injection. The duration of the experiment was limited in advance to 30 minutes, and urine was not collected. An attempt was made to reduce the number of necessary blood samples by means of external monitoring. The investigations were made along with isotope renography and the results were compared with the clearance of f-aminohippuric acid. (auth)

15127 CHRONIC ADMINISTRATION OF ^{137}Cs RESULTING FROM RADIOACTIVE FALLOUT TO RUMINANTS. Hanout, R.; Daburon, F.; Duclos, J. (CEA, Jouy-en-Josas, France). Radioprotection; 7: No. 3, 181-190(1972). (In French).

The metabolism of fallout ^{137}Cs was studied. Two ewes and a cow were fed with a heavily contaminated two-year-old hay. The principal causes of error in this type of experiment are discussed. The results of these investigations are compared with other data, the conclusions of which have been confirmed. (auth)

Plants

15128 USE OF GROUND MOSS (GRIMMIA ORBICULARIS BRUCH) FOR INDICATING THE PRESENCE OF ^{54}Mg, ^{137}Cs, AND ^{90}Sr. Hebrard, J. P. (CNRS, Marseille); Foulquier, L.; Grauby, A. Radioprotection; 7: No. 3, 159-177(1972). (In French).

Ground moss (Grimmia orbicularis Bruch) was experimentally contaminated with ^{54}Mn, ^{137}Cs, and ^{90}Sr. The plant fixing capacity from the water and soil was studied for each radionuclide. The role of the hygrometric variations on the kinetics and intensity of the contamination was studied. The respective values for the concentration factors of ^{54}Mn, ^{137}Cs, and ^{90}Sr are of the order of 700, between 90 and 180, and between 100 and 500. The alternating drying and rehydrating phases of the medium have little effect on the fixation rate for these radionuclides. (France)

15129 EFFECT OF SOIL pH AND CHELATING AGENT (DTPA) ON UPTAKE BY AND DISTRIBUTION OF ^{241}Am IN PLANT PARTS OF BUSH BEANS. Wallace, A. (Univ. of California, Riverside). Radiat. Bot.; 12: No. 6, 433-435(Dec 1972).

Bush bean (Phaseolus vulgaris L. var. Improved Tendergreen) plants were grown with and without the chelating agent diethylenetriaminepentaacetate (DTPA) in Yolo loam soil, which was amended to give a range of soil pH values. A level of 1.68 μCi ^{241}Am was uniformly mixed with each 500 g quantity of soil. Highest amounts of ^{241}Am and highest leaf-stem ratios for the ^{241}Am were found in plant parts at soil pH around 7.7 with the DTPA. The results are interpreted as chelated ^{241}Am not only being available to the plants especially at pH 7.7 but also the ^{241}Am being transported through the plants as the metal chelate. (auth)

15130 UPTAKE AND DISTRIBUTION OF ^{210}Po AND ^{210}Pb IN TOBACCO PLANTS. Athalye, V. V.; Mistry, K. B. (Bhabha Atomic Research Centre, Bombay). Radiat. Bot.; 12: No. 6, 421-425(Dec 1972).

The uptake and distribution of polonium-210 and its long-lived precursor lead-210 in two flue-cured tobacco varieties (Nicotiana tabacum L. cv. Delcrest and cv. Virginia gold), were examined in nutrient culture experiments. The accumulation of these radionuclides was greatest in the roots. Over identical durations of growth, the extent of upward transport of ^{210}Po and ^{210}Pb was relatively greater in cv. Virginia gold. The distribution of the radionuclides in aerial tissues followed an acropetal gradient suggesting that ^{210}Pb and ^{210}Pb concentrations in leaf tobacco used for cigarette production would be reduced if leaves other than the oldest pairs are harvested. (auth)

New Tracer Techniques

Refer also to abstracts 15003, 15017, and 15097.

15131 GRANULOCYTE CHEMOTAXIS: AN IMPROVED IN VITRO ASSAY EMPLOYING ^{51}Cr-LABELED GRANULOCYTES. Gallin, J. I.; Clark, R. A.; Kimball, H. R. (Lab. of Clinical Investigation, Bethesda, MD). J. Immunol.; 110: No. 1, 233-40 (Jan 1973).

A radioassay of granulocyte chemotaxis employing chromium-51-labeled cells and a double micropore filter system is presented. In comparison to the conventional Boyden chamber technique, this method offers significant advantages including: elimination of tedious filter staining and microscope counting resulting in a considerable saving in laboratory time, elimination of observer subjectivity, excellent sensitivity over a wide range of cell responses with no increase in variability, ability to monitor cellular events in all compartments of the chemotaxis chamber, and a means for standardization of neutrophil chemotaxis among different laboratories. (auth)

15132 SOLID-PHASE RADIOIMMUNE ASSAY USING ^{3}H-LABELED ANTIGEN FOR THE MOUSE OLFACTORY BULB SPECIFIC PROTEIN. Margolis, F. L. (Roche Inst. of Molecular Biology, Nutley, NJ). Anal. Biochem.; 50: No. 2, 602-7(Dec 1972).

To avoid certain disadvantages attendant upon the use of radioiodination to label antigens, the technique of reductive-alkylation utilizing high specific activity NaB^3H_4 has been utilized to tritiate an antigen. With this tritiated protein a rapid, sensitive, reproducible radioimmune assay for the mouse olfactory bulb specific protein has been developed. The data obtained by this method are in excellent agreement with previous results obtained by immunoprecipitation titrations and demonstrate that this method of labeling offers a viable alternative to the use of radioiodine labeled antigens. (auth)

15133 QUANTITATIVE DETERMINATION OF INDIVIDUAL SERUM PROTEINS BY ELECTROIMMUNOASSAY AND USE OF ^{125}I-LABELLED ANTIBODIES (APPLICATION TO C-REACTIVE PROTEIN). Kindmark, C. O. (Malmoe General Hospital, Sweden); Thorell, J. I. Scand. J. Clin. Lab. Invest.; 29: Suppl. 124, 49-53 (1972).

The sensitivity of quantitative electrophoresis into agarose gel containing antibodies was increased about 60-fold by incorporation of radioactive antibodies in the precipitates. The precipitates were visualised by autoradiography. The technique was exemplified with the use of rabbit-anti-CRP-gammaglobulin-^{125}I in the quantification of CRP. The method, which can measure the proteins down to a concentration of 0.01 mg/l, invariably demonstrated CRP in apparently healthy blood donors. (auth)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 14636, 14653, 14701, 14937, 14969, 15177, 15248, 15249, 15252, 16404, 16447, 16452, 16453, 16461, 16463, 16509, 16533, 16831, 16835, and 16836.

15134 (AREE-M-2565) EFFECT OF POROSITY ON THE ELASTIC MODULI OF UO_2 AS MEASURED BY AN ULTRASONIC TECHNIQUE. Boocock, J.; Furzer, A. S.; Matthews, J. R. (Atomic Energy Research Establishment, Harwell (England)). Sep 1972. 21p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

An apparatus for the measurement of elastic constants from ultrasonic wave velocities has been constructed. This has been used to determine the effects of fabrication pores on the moduli of UO_2. The effects of different types of porosity were found to be consistent with current theory. Corrections of the form $(1 - p)/(1 + 2.3\ p)$ and $(1 - p)/(1 + 4.5\ p)$ have been suggested for shear modulus and bulk modulus, respectively. Measurements have also been made on mixed UO_2 and PuO_2 with and without simulated fission products. (auth)

15135 (AERE-M-2566) METHODS OF SPECIMEN PREPARATION FOR TRANSMISSION ELECTRON MICROSCOPY. Harper, E. A. (Atomic Energy Research Establishment, Harwell (England)). Oct 1972. 21p. Dep. NTIS (U.S. Sales Only). UK 50 pence.

A range of materials was examined, resulting in the development of techniques for preparation of thin films for transmission electron microscopy. Apparatus for obtaining thin areas in ceramic materials by grinding, electropolishing methods, and ion-beam thinning are described. Suspension methods for submicron powders, rolling techniques for use on pure metals, and the use of the ultra-microtone on biological material are briefly described. (auth)

15136 (BN-7201-2) SHORT HIGH SPECIFIC POWER IRRADIATIONS OF MIXED U AND Pu OXIDE FUELS. Lhost, A.; van Outryve d'Ydewalle, B. (Societe Belge pour l'Industrie Nucleaire, Brussels). Jan 1972. vp. (In French). INIS.

Studies were made on the recycling of Pu in light water reactors. Some incidences of fabrication techniques for mixtures of oxide fuels are discussed. Fuel rods with pellet-type fuel (especially Pu-containing) were irradiated for short duration and heat transfer and structural modifications during the initial phase of irradiation were noted. Three types of Zircaloy-2-clad fuel rods with pellet type fuel, $(Pu-U)O_2$, in homogeneous or heterogeneous mixture were tested with power sometimes attaining 1100 W/cm for periods varying from 15 min to 30 h. The effects of the time interval for bringing up to power and the irradiation temperature were examined in connection with the formation of the central void, distribution of temperature in the fuel, and its morphology. The results of the irradiation of rods with pellet-type fuel can be in-put in the file on information for the adjustment of the COMETHE code. (tr-auth)

15137 (EUR-4863) POST-IRRADIATION EXAMINATION OF THE FUEL ROD CART-C1 NO. 4. Frigo, A.; Klersy, R.; Schrader, K. H.; Schuerenkaemper, A.; Benvenuti, A.; Camona, G.; Mantega, F. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Nov 1972. 42p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 60.-.

Results of post-irradiation examinations on the fuel rod are presented. Nondestructive gamma-scanning analysis shows a migration of Cs inside the fuel and a more or less homogeneous distribution of the fission products Zr, Nb, Ce-Pr, and Ru. Results of metallographic studies show zirconium hydrides over the whole thickness and oxide layers on the surfaces of the cladding. The welding zone appears perfect. The alteration of the microstructure of the fuel due to the irradiation is shown. (auth)

15138 (GEAP-12318) THERMODYNAMIC DATA PROGRAM INVOLVING PLUTONIA AND URANIA AT HIGH TEMPERATURES. Quarterly Report No. 19, February 1-April 30, 1972. Aitken, E. A.; Dutina, D.; Adamson, M. G.; Evans, S. K.; Ludlow, T. E. (General Electric Co., Pleasanton, Calif. Vallecitos Nuclear Center). Jul 1972. Contract AT(04-3)-189. 25p. Dep. NTIS.

Work progress is reported on the continuing scope of work related to oxygen redistribution in a temperature gradient, Pu/U segregation, sodium-fuel chemical interactions, and fission product cladding reactions. (auth)

15139 (JUL-863-RG) DETERMINATION OF THE RELEASE BEHAVIOUR OF HELIUM AND TRITIUM FROM NEUTRON-IRRADIATED SINTERED BeO COMPACTS. Stoever, D. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Jun 1972. 142p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Technische Hochschule, Aachen (West Germany).

Results of post-irradiation investigations on neutron-irradiated sintered BeO compacts are reported. The macroscopic-mechanical properties of the samples such as density, porosity, and Young's modulus is discussed as well as the radiation damage of both composition and lattice structure. By means of a specially developed vacuum assembly, the release behavior of helium was studied both isothermal and with a varying function of temperature and time. The detection of tritium is made by an integral method by means of a scintillation spectrometry. An absolute determination of the total contents of helium and tritium in the samples is achieved by a chemical analysis. The results of the measurements are discussed, and they are described quantitatively by the application of a modified diffusion theory. (auth)

15140 (LA-5067) ADVANCED PLUTONIUM FUELS PROGRAM. Quarterly Progress Report, April 1-June 30, 1972. Baker, R. D. (comp.) (Los Alamos Scientific Lab., N. Mex.). Oct 1972. Contract W-7405-eng-36. 45p. Dep. NTIS.

Most of the investigations discussed are of the continuing type. Results and conclusions described may therefore be changed or augmented as the work continues. Information is included on results of reactor fuel examination, evaluation of LMFBR fuels, and analytical standards for fast breeder reactor fuels. (JRD)

15141 (ORNL-4802) SOL-GEL PROCESS: ENGINEERING-SCALE DEMONSTRATION OF THE PREPARATION OF HIGH-DENSITY UO_2 MICROSPHERES. Finney, B. C.; Haas, P. A. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 44p. Dep. NTIS.

A sol-gel process for the preparation of high-density UO_2 microspheres in the size range 125 to 210 μ was demonstrated on an engineering scale. The process consists of preparing a 1 M UO_2 sol by the CUSP process, forming the sol into gelled spheres in a nonfluidized column using hot 2-ethyl-1-hexanol as the dehydrating agent, and calcining the gelled spheres to dense UO_2. Eight batches of sol containing approximately 4 kg of UO_2 each were prepared, and microspheres were produced in a microsphere forming column that was operated continuously for two one-week periods. Drying was carried out in glass product catchers; firing was done in alumina crucibles in a muffle furnace. Four batches of sol were prepared the week prior to each microsphere forming run. Sols with NO_3^-/U mole ratios of 0.09 to 0.14, $HCOO^-/U$ mole ratios of 0.38 to 0.47, and U(IV) contents of 85 to 87% were prepared following the standard CUSP operating path. Overall uranium material balances for the two demonstration runs were 102.2 and 104%, and the sol yields were 98 and 96.5%, respectively. No differences were noted in the microsphere forming properties of the various batches of sol. The performance of the nonfluidized microsphere forming column was satisfactory. Minor difficulty was encountered with plugging of the two-fluid nozzle capillaries; however, this was minimized by installing glass frit filters in the sol feed line. An on-stream factor of 96% was attained for each run. The desired production capacity of approximately 3 kg of UO_2 per day was attained during the second run. Operating conditions were established during the first run. Results of the second run indicated an 86.8% yield of calcined microspheres in the size range 125 to 210 μ. The mean size varied from approximately 158 to 167 μ, with a standard deviation of approximately 10%. The O/U atom ratio was 2.003 to 2.005, and the carbon and iron contents were 24 to 60 and 12 to 46 ppm, respectively. (auth)

15142 (UCRL-51269) FINAL REPORT OF THE LIGHT ARMOR MATERIALS PROGRAM. Landingham, R. L.; Casey, A. W. (California Univ., Livermore. Lawrence Livermore Lab.). 15 Sep 1972. Contract W-7405-eng-48. 54p. Dep. NTIS.

Beryllium boride compounds have been evaluated as potential materials for use in light armor applications. Target specimens have been prepared by hot-pressing and casting techniques and subjected to ballistic testing. In each case, ballistic performance was found to be strongly related to composition and to the microstructure of the target material. One important microstructural feature has been found to be the grain size of the target material. The mechanism of fracture is described and the relationship of the type of fracture to grain size is discussed. It has been shown

that grain size can in some cases be controlled by process variables. Toxicity investigations have also been carried out. As a part of these toxicity studies the amount and size distribution of ballistic debris has been determined. Environmental studies have shown the beryllium borides to be resistant to high temperature oxidation and thermal shock, but adversely affected by salt water. A working Be–B phase diagram is also provided. The ballistic performance of beryllium borides was improved when they were incorporated in metal-graded targets. (auth)

15143 (WAPD-TM-908) THERMAL CONDUCTIVITY OF POLYCRYSTALLINE THORIA AND THORIA–URANIA SOLID SOLUTIONS. (LWBR DEVELOPMENT PROGRAM). Berman, R. M.; Tully, T. S.; Belle, J.; Goldberg, I. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Dec 1972. Contract AT-11-1-GEN-14. 53p. Dep. NTIS.

An empirical correlation, using least-squares techniques, was made of the variation of thermal conductivity for thoria–urania fuels with temperature, composition, porosity, microstructure, cracks, and fission depletion. Thermal conductivities of unirradiated ThO and ThO_2–UO_2 were calculated from measurements of thermal diffusivity, enthalpy, and expansivity. The standard deviation of the residuals served as a criterion of the success of a particular mathematical model in fitting the data. Six parameters were required for an adequate fit of the thermal conductivity of 100 dense, unirradiated fuel: $K_0 = [A_0 + A_1U + A_2U^2 + (B_0 + B_1U + B_2U^2)T]^{-1}$ w/cm°C. A correction for porosity was made using the Maxwell–Eucken relationship $K/K_0 = (1 - p/1 + \beta p$ where β is dependent primarily on pore shape. The best-fit model for β was that proposed by Marino, in which β is made a function of ϵ, the axial ratio of the pores, and γ, the ratio between the effective conductivity of the pores and that of the matrix. The best-fit value for ϵ was found to be 0.1637 ± 0.0733. The increment in thermal resistance caused by increments of crack of area da is proportional to $\int da \sin \phi$, where ϕ is the angle between the crack and the direction of heat flux. The integral can be most readily evaluated by drawing a series of traverses across a photomicrograph of the cross section, counting the number of times the traverses intersect cracks, and dividing by the number of traverses. (auth)

15144 (WAPD-TM-1051) HOMOGENIZATION OF ThO_2–UO_2. (LWBR DEVELOPMENT PROGRAM). Berman, R. M. (Bettis Atomic Power Lab., Pittsburgh, Pa.). Dec 1972. Contract AT-11-1-GEN-14. 46p. Dep. NTIS.

The homogenization of ThO_2–UO_2 occurs by volume diffusion, augmented by grain-boundary and surface diffusion. The interdiffusion coefficient was determined by electron probe, ion probe, x-ray diffraction, and autoradiographic techniques for temperatures between 1500 and 2200°C. Results were fitted to the equation: $D^* = 1.125 \times 10^{-5} \exp[-62200/RT]cm^2/sec$. As a result of the Kirkendall effect, pores form at the high-urania margin of the diffusion zone that develops around the periphery of each UO_2 grain. At early stages of the dissolution, these pores are elongated and parallel to the periphery. The solid material inside the high-urania edge of the diffusion zone is nearly pure UO_2, and remains so until the final stages of dissolution. As homogenization proceeds, the pores grow at the expense of this material. At the final stages, the inhomogeneity consists essentially of a pore with a thin lining of high-urania material. (auth)

15145 VAPORIZATION THERMODYNAMICS OF YTTERBIUM DIHYDRIDE. Haschke, J. M.; Clark, M. R. (Univ. of Michigan, Ann Arbor). High Temp. Sci.; 4: No. 5, 386-92(Oct 1972).

Stoichiometric ytterbium dihydride has been found to vaporize congruently according to the reaction $YbH_2(s) \rightarrow Yb(g) + H_2(g)$. Equilibrium vapor pressures have been measured by a weight-loss Knudsen effusion technique in the temperature range 726–930 K. For the vaporization reaction, $\Delta H^\circ_{828} = 75.5_0 \pm 0.8_2$ kcal/gfw and $\Delta S^\circ_{828} = 49.1_1 \pm 0.9_6$ eu. The heat capacity of the dihydride has been estimated and second- and third-law results are presented. For $YbH_2(s)$, $\Delta H^\circ_{f298} = -42._9 \pm 1._2$ kcal/gfw, $\Delta G^\circ_{f298} = -34._2 \pm 1._3$ kcal/gfw and $S^\circ_{298} = 16.0 \pm 1._7$ eu. Preparative results, thermodynamic data and similarities with the analogous alkaline earth systems are discussed. (auth)

15146 WEAR RESISTANCE OF FACINGS WITH NITROGEN. Mamaev, L. N.; Grinberg, N. A.; Livshits, L. S. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 527-8(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 6, 54-5(Jun 1972).

The wear resistance of metal nitrides was investigated. It was found that alloying of wear resistant facing materials with nitrogen in the presence of strongly nitride-forming elements makes it possible to increase the wear resistance two to three times as compared with similar alloys without nitrogen and does not lower the resistance to impact loading. Nitrogen forms hard finely dispersed carbonitrides in the facing metal, promotes the formation of carbides with a high wear resistance, and refines the grains. This increases the wear resistance and improves the plastic characteristics of the alloy. Alloy U13Kh7N2TA, with an elevated nitrogen content, has been developed for industrial use. (auth)

15147 POROSITY DEPENDENCE OF THERMAL CONDUCTIVITY OF URANIUM MONONITRIDE. Kikuchi, T.; Takahashi, T.; Nasu, S. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 45: No. 4, 284-292(Jan 1973).

The thermal diffusivity of sintered uranium mononitrides of various densities (70 to 95%) was measured over the temperature range from 300 to 1400°C. The curve of thermal diffusivity versus porosity at each temperature exhibited a break at porosity near 0.1. Thermal conductivity obtained from thermal diffusivity was found to be well fitted to a set of the simplified Maxwell–Eucken equations. The coefficient β in the equation was obtained as 1.68 to 1.86 for the porosity range above 0.10 and that for the smaller porosity range varied from 1.38 at 300°C to −0.09 at 1300°C. The porosity dependence of thermal conductivity of the porous material is discussed, taking account of the effect of pore conduction in a similar way as conducted by Marino. The calculated results for the larger porosity is in agreement with the experimental ones, whereas that for the smaller porosity is not wholly consistent with the experiments. (auth)

15148 CHEMICAL THERMODYNAMIC PROPERTIES OF NUCLEAR MATERIALS. II. HIGH TEMPERATURE ENTHALPY OF THE URANIUM CARBIDES. Oetting, F. L. (Dow Chemical Co., Golden, CO); Navratil, J. D.; Storms, E. K. J. Nucl. Mater.; 45: No. 4, 271-283(Jan 1973).

The high-temperature enthalpy of uranium monocarbide, uranium sesquicarbide and uranium dicarbide has been determined by a copper block drop calorimeter of the isoperibol type. The experimental data cover the temperature range to 1700°K relative to 298°K for the monocarbide and sesquicarbide, and to 1500°K relative to 298°K for the dicarbide. These results combined with the heat capacity and entropy of the respective carbide at 298°K available from the literature made it possible to construct tables of thermodynamic functions for the uranium carbides. The unusual behavior of the heat capacity of uranium sesquicarbide, and to some extent uranium monocarbide, is correlated to a vacancy formation of 19.5 kcal/mol for uranium sesquicarbide and 23.4 kcal/mol for uranium monocarbide, respectively. (auth)

15149 PROPERTIES OF URANIUM VACANCIES IN URANIUM MONOCARBIDE. Donner, D.; Schuele, W. (CCR-EURATOM, Ispra, Italy). J. Nucl. Mater.; 45: No. 4, 293-301(Jan 1973).

From the excess resistivity obtained by quenching from temperatures between 1300 and 1600°C a formation energy of 1.7 eV is determined. The quenched-in resistivity recovers with an activation energy of 2.2 eV in the temperature region between 400 and 600°C. These two values are attributed to the formation and migration activation energies of uranium vacancies, respectively. It is further shown that uranium monocarbide remains single-phase, if the deviation from stoichiometry does not exceed more than a few tenths of one percent and if gases (mainly oxygen) are in solid solution. (auth)

15150 FRACTURE STRESS AND ELASTIC MODULUS OF URANIUM DIOXIDE INCLUDING EXCESS OXYGEN. Igata, N. (Tokyo Univ.); Domoto, K. J. Nucl. Mater.; 45: No. 4, 317-322 (Jan 1973).

The effects of porosity, grain size and excess oxygen on Young's modulus and fracture strength for sintered pellets of compositions from $UO_{2.00}$ to $UO_{2.25}$ were investigated at room temperature. Young's modulus was determined using the ultrasonic method and fracture strength was measured in compression. The results are shown in numerical formulas and are interpreted by the authors' theory or by published theories. (auth)

15151 NEUTRON IRRADIATION REDUCES THE MECHANICAL PROPERTIES OF REACTION-BONDED SILICON CARBIDE. Matthews, R. B.; Hutchings, W. G. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba). J. Nucl. Mater.; 45: No. 4, 341-342(Jan 1973).

Bend-test samples (50 × 6 × 3 mm) of reaction-bonded SiO were irradiated in an organic-cooled reactor (WRl) at 400 and 700°C to fast neutron fluences (E > 1 MeV) of 1.1×10^{20} and 3.3×10^{20} n/cm². Young's modulus was determined from the resonant frequency of the flexural mode of vibration of the samples and fracture strengths of four-point loading to failure. After initial irradiation, fracture strength drops drastically but does not decrease noticeably with increasing fluence. The wide variability in fracture strength hides possible temperature effects. Irradiation also significantly reduces Young's modulus. (TFD)

15152 HYDROGEN INTERACTION WITH YTTRIUM AND LANTHANUM OXIDES. Loginov, A. Yu.; Kreisberg, V. A.; Topchieva, K. V. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 4, 389-94(1972). (In Russian).

Hydrogen adsorption on yttrium and lanthanum oxides has been investigated in a wide temperature range. Four types of hydrogen interaction with the oxide surface were observed. High-temperature vacuum and hydrogen treatment of the catalyst, which is necessary for low temperature hydrogenation, results in the formation of coordinatively and valence unsaturated metal ions. (auth)

15153 POSSIBLE STRUCTURE OF ISOTHERMAL CROSS SECTIONS OF THE SYSTEM Zr–W–C AT 2200 AND 2600°C. Vil'k, Yu. N.; Ordan'yan, S. S.; Avgustinik, A. I. (Leningrad Technological Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 7, 1096-8(Jul 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 7, 1245-8(Jul 1972).

The reaction of W with ZrC at 2200 and 2600°C was investigated. It was shown that at these temperatures the cross section ZrC–W in the system Zr–W–C is pseudobinary. Diagrams of the isothermal cross sections of the ternary system Zr–W–C at 2200 and 2600°C were constructed. (auth)

15154 DEFECT CONTENT AND DISSOCIATION MECHANISM OF MgO-BASED SOLID SOLUTIONS IN THE SYSTEM Sc_2O_3–MgO. Lopato, L. M.; Ogorodnikova, A. A.; Shevchenko, A. V. (Inst. of Problems in Materials Science, Kiev). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 7, 1111-16(Jul 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 7, 1264-9(Jul 1972).

The kinetics of dissociation of Sc_2O_3–MgO solid solutions were investigated. By annealing and quenching, and by high-temperature DTA, the data on the phase diagram of the system Sc_2O_3–MgO were refined. By comparing the experimental density with the theoretical densities predicted by a model with cation vacancies and a model with interstitial anions, a conclusion was reached that the solid solution of Sc_2O_3 in magnesium oxide contains cation vacancies. Quantitative x-ray analysis was used to study the kinetics of separation of scandium oxide from a supersaturated MgO-based solid solution. Analysis of the kinetic curves revealed that the dissociation process is diffusion-controlled and closely obeys the law $\alpha = 1 - \exp[-(t/\tau)^n]$. The value of n is close to 1.4. (auth)

15155 DISSOCIATION OF CADMIUM OXIDE DURING EVAPORATION. Ivanov, G. A.; Savitskaya, Ya. S. (Inst. of Radio Engineering and Electronics, Moscow). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 7, 1163-5(Jul 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 7, 1319-20(Jul 1972).

An analysis of literature data was conducted to select the correct equilibrium constants for formation of CdO (solid) from the parameters and degree of dissociation of CdO (solid) during evaporation. It was concluded that data on the temperature dependence of pressure for undissociated CdO (gas) molecules can only be used for rough calculations. (JRD)

15156 STABILITY OF REACTIVE AND REFRACTORY METAL BORIDES IN TERNARY CHROMIUM-BASE ALLOYS. Filippi, A. M. (Westinghouse Astronuclear Lab., Pittsburgh). J. Less-Common Metals; 30: 153-8(1973).

Boride formation and stability at elevated temperatures have been examined for the chromium-base alloys Cr–1.0 Ti–0.5 B (at.%), Cr–1.0 Nb–0.5 B, Cr–0.5 M–0.5 B, and Cr–0.5 M–0.25 B, where M represents Ti, Zr, Nb, or Ta. Emphasis was placed on stability in the temperature range 1149 to 1482°C. The evidence indicated that ZrB and ZrB_2 are stable in both Cr–Zr–B alloys over the 1149 to 1482°C temperature range. Mixed metal borides of similar diffraction patterns form in the Cr–Nb–B and Cr–Ta–B compositions. A proposed formula for these compounds is $(M, Cr)_3B_2$, M/Cr ~ 2, M representing Ta or Nb. An overall analysis of results obtained for the Cr–Ta–B and Cr–Nb–B alloys indicated that a transformation of boride stability from the $(M,Cr)_3B_2$ phases to Cr_4B is generally favored at high temperatures and is strongly influenced by composition. The $(M, Cr)_3B_2$ phases were stable to the highest temperatures in the compositions examined which contained a 2 to 1 alloying metal-to-boron ratio. The Cr_4B phase alone formed in the Cr–Ti–B alloys at high temperatures. (PCH)

15157 STUDY OF THE TERNARY SYSTEM NIOBIUM–OXYGEN–SULFUR AND ESTIMATION OF THE THERMODYNAMIC PROPERTIES OF NIOBIUM SULFIDES. Hodouin, D. (Ecole de Mines de Paris, Corbeil, France). J. Less-Common Metals; 30: 127-39(1973). (In French).

The ternary phase diagram Nb–O–S has been studied in the region bounded by the compounds NbO, $Nb_{1-x}S$, NbS_2, and Nb_2O_5. Only the known binary phases present in the Nb–S and Nb–O systems were observed. In its most stable form, $Nb_{1-x}S$ is in equilibrium either with NbO or NbO_2 depending upon its composition. The NbO_2–Nb_2O_5 transition takes place at the sulphur-rich limit of 2s $Nb_{1+x}S_2$. The 3s $Nb_{1+x}S_2$, 3s NbS_2 and Nb_2O_5 phases are in equilibrium at about 750°C under p_{S_2} = 1 atm. From these results and Larson and Elliott's measurements, the free energy of formation of $Nb_{1.12}S_2$ has been calculated and those of the other sulfides estimated at 1000°C. (auth)

15158 HYDROCHLORIDES OF ZIRCONIUM OXIDE. Blumenthal, W. B. (NL Industries, Inc., Niagara Falls, NY). J. Less-Common Metals; 30: 39-46(1973).

Crystalline zirconium dioxide is insoluble in hydrochloric acid. Under certain conditions, zirconium dioxide can be formed in hydrochloric acid solutions as oligomers or as chain polymers. Both form hydrochlorides with ratio $HCl : ZrO_2 = 1$. The hydrochloride oligomer can be crystallized from acidic solution, with crystal composition $(ZrO_2 \cdot 4\ H_2O)_4 \cdot 4\ HCl \cdot (12\ H_2O + 4\ HCl)$. The water and hydrogen chloride represented in parentheses are guests in the crystal lattice. The polymers do not crystallize, but can be recovered as water-soluble glasses, containing relatively little water. The arrangement of the ZrO_2 units in the polymers, and to a lesser extent in the oligomers, is variable. The chemical behavior of these hydrochlorides and its relationship to their molecular structures are discussed. (auth)

15159 ELIMINATION OF CO_2 AND H_2O AS OXYGEN TRANSPORT SPECIES IN MIXED OXIDE FUEL PINS. Leitnaker, J. M. (Oak Ridge National Lab., TN); Spear, K. E. J. Nucl. Mater.; 45: No. 3, 195-200(Dec 1972).

Thermodynamic and kinetic calculations showed that both CO_2 and H_2O are eliminated as oxygen transporting species in typical, near-stoichiometric LMFBR mixed oxide fuel. Thus, current gas phase transport theories do not correctly describe the oxygen distribution in such a pin. A method for measurement of the oxygen potential across an oxide fuel pin is presented. (auth)

15160 STUDY OF LOCAL COMPOSITION VARIATIONS IN IRRADIATED OXIDE FUEL BY X-RAY DIFFRACTOMETRY. Benedict, U.; Coquerelle, M.; De Bueger, J.; Dufour, C. (Europaisches Institut fuer Transurane, Karlsruhe, Ger.). J. Nucl. Mater.; 45: No. 3, 217-29(Dec 1972).

Microsamples were taken at different distances from the center from transversal metallographic sections of 1 at.% burn-up mixed oxide fuel irradiated in the DFR. A method of measuring the lattice parameter of the matrix on these microsamples was developed. After correction for the fission product content of the matrix and Pu-self-irradiation, the lattice parameters were converted to O/M ratios using a relation a = f(O/M) derived from earlier phase studies. For an initial O/M ratio of about 1.99, oxygen distributions of the type predicted by the Markin–Rand theory, but with lower oxygen gradients, were obtained. For lower O/M ratios, the results seem to indicate that oxygen segregation existing during irradiation had disappeared during cooling, oxygen diffusion being faster at lower overall O/M ratios. (auth)

15161 URANIUM POSITIONS IN CUBIC U_2N_{3+x}. Masaki, N.; Tagawa, H.; Tsuji, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 45: No. 3, 230-4(Dec 1972).

Uranium positions in cubic U_2N_{3+x} have been determined by the x-ray powder diffraction method with respect to the relation between uranium positions and the nitrogen contents. Uranium positions are described with a constant parameter value: Ia3, 8(b) and 24(d) of composition z = −0.015, in the $0.19 \leq x \leq 0.37$ region. (auth)

15162 FORMATION OF THE GAMMA PHASE BY A PERITECTOID REACTION IN THE ZIRCONIUM–HYDROGEN SYSTEM. Mishra, S.; Sivaramakrishnan, K. S.; Asundi, M. K. (Bhabha Atomic Research Centre, Bombay). J. Nucl. Mater.; 45: No. 3, 235-44(Dec 1972).

Studies on the zirconium–hydrogen system have indicated that a peritectoid reaction occurs at about 255°C between the α and δ phases to give the γ phase. This reaction is dependent upon the interfacial contact and hence is sluggish if the two phases are in massive form. The γ is a stable phase of composition ZrH below 255°C and decomposes rapidly if heated above this temperature to give α and δ phases. Quenched α with saturated hydrogen, or δ of high-temperature composition, precipitate the γ phase at room temperature and require a long time for completion of the process. Non-equilibrium δ phases in a 49 at.% hydrogen alloy, on β quenching and room-temperature ageing, may transform fully to γ phase by a shear type of mechanism quite similar to the δ to ϵ transformation. (auth)

15163 MEASUREMENT OF YOUNG'S MODULUS AND FRACTURE STRESS ON HTR PARTICLE COATINGS BY THE BRITTLE RING TEST. Bongartz, K.; Gyarmati, E.; Nickel, H.; Schuster, H.;

Winter, W. (Institut fuer Reaktorwerkstoffe, Juelich, Ger.). J. Nucl. Mater.; 45: No. 3, 261-4(Dec 1972).

A method that was developed to fulfil the three requirements for measuring Young's modulus and fracture stress is described. The method comprises a new specimen preparation technique by which rings are obtained from individual coating shells, and the use of a special compression testing machine which deforms the rings diametrically and plots the corresponding load-deflection curve up to the breaking point. The curve can be treated analytically to obtain the desired values. Results for Young's modulus and fracture stress measured on SiC with two different thicknesses gave higher figures for the thinner specimens. This correlates well with the structure of the material, which shows the grain size to be smaller for the specimens with the thinner layers. The data presented are within the range of values for SiC obtained on SiC strips subjected to the bending test, which produces a similar stress distribution in the specimens as occurs in the ring test. Results on PyC rings deposited from propylene showed good agreement with results obtained by application of the 3-point bending test to PyC strips of similar structure deposited from propylene. (PCH)

15164 PHASE EQUILIBRIUM RELATIONS IN THE MoO_2–FeO–Fe_3O_4 SYSTEM AT 1140°C. Abe, Masanori (Tokyo Inst. of Tech.). Mater. Res. Bull.; 7: No. 12, 1443-51(Dec 1972).

Phase equilibrium relations in the $MoO_2-FeO-Fe_3O_4$ system at 1140°C were determined by changing the oxygen partial pressure ranging from $10^{-12.7}$ to $10^{-7.8}$ atm and an isothermal phase diagram is presented. The following oxide phases have stable equilibrium existence under these conditions: a ternary compound $2FeO \cdot 3MoO_2$ with a distorted hexagonal structure, a spinel solid solution system $2FeO \cdot MoO_2-Fe_3O_4$, and the wustite solid solution $Fe_{1-y}O$ which is considered to dissolve molybdenum ions in less than 3.3 atomic %. (auth)

15165 PHASE EQUILIBRIUM IN THE SYSTEM TeO_2–V_2O_5. Marinov, M. R.; Kozhukharov, V. S.; Pavlova, Yu. N. (Inst. of Chemical Tech., Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 10, 1355-1358(1972). (In Russian).

A melting point diagram was constructed for the binary system $TeO_2-V_2O_5$, in the temperature range from about 300° to 733°C (the melting point of TeO_2). The compound $2TeO_2 \cdot V_2O_5$ melted congruently at 485°C, and gave rise to the formation of two eutectic compositions: one with 43 mole % V_2O_5 melting at 475°C, and the second at 25 mole % V_2O_5 melting at 469°C. Samples in the concentration range between TeO_2 and $2TeO_2 \cdot V_2O_5$ showed an exoeffect of crystallization at 320°C; samples between $2TeO_2 \cdot V_2O_5$ and V_2O_5 showed an exoeffect at 326°C. (KSW)

15166 THORIA STABILITY IN TD-NiCr AT HIGH TEMPERATURES IN THE PRESENCE OF CHROMIUM IN SOLUTION. Dalal, H. (SKF Industries, Inc., King of Prussia, PA); Grant, N. J. Met. Trans.; 4: No. 1, 381-3(Jan 1973).

Studies were made on the effects of Cr in solid solution on the coarsening of ThO_2 in TD–NiCr. Comparison was made of ThO_2 coarsening in Cr-free TD–Ni and in TD–NiCr. The results indicated that the presence of 20% Cr in solid solution in a Ni-base alloy does not lead to more rapid coarsening of ThO_2 to temperature of at least 2462°F (1350°C). Coarsening of ThO_2 in TD–Ni and TD–NiCr was diffusion dependent and independent of Cr in solution. (PCH)

15167 TRANSITION METAL ALLOYS OF EXTRAORDINARY STABILITY; AN EXAMPLE OF GENERALIZED LEWIS-ACID-BASE INTERACTIONS IN METALLIC SYSTEMS. Brewer, L. (Univ. of California, Berkeley); Wengert, P. R. Met. Trans.; 4: No. 1, 83-104(Jan 1973).

The Engel theory of metals predicts unusually high thermodynamic stability for certain classes of alloys of transition metals for which generalized Lewis-acid-base interactions are possible. To test these predictions, phase equilibria were studied for ternary systems of Zr, C, and the transition metals Re, Ru, Os, Rh, Ir, Pd, Pt, Ag, and Au. Similar literature data for Nb, Ta, Hf, Th, Y, Ce, Er, and Pu with Re, Ru, Rh, Ir, Pt, and Au were evaluated. Thermodynamic data for the carbides of Zr, Hf, Th, Nb, Ta, U, and Y were critically evaluated, tabulated for 1200 to 2300°K, and used to fix the Gibbs energies of formation in kcal/g-atom of alloy, or their limits, for the binary phases of the above metals. In addition, for Zr, activity coefficients and excess Gibbs energies are tabulated. The predicted high stabilities for alloys of Rh, Ir, Pd, and Pt were confirmed with excess Gibbs energies ranging to –100 kcal/g-atom and activity coefficients as low as 10^{-12} for zirconium or hafnium in dilute solutions of platinum at 1800 K. Some of the properties of these unusually stable compounds have been measured. (94 references) (auth)

15168 ELECTRONIC CONDUCTIVITIES OF COMMERCIAL ZrO_2 + 3 TO 4 WT. PCT CaO ELECTROLYTES. Friedman, L. M. (Ohio State Univ., Columbus); Oberg, K. E.; Boorstein, W. M.; Rapp, R. A. Met. Trans.; 4: No. 1, 69-74(Jan 1973).

Potentiostatic electrochemical experiments with liquid metal electrodes have been analyzed to provide values for the mixed electrical conduction parameters (σ_{ion}, $\sigma^0_\ominus$, $\sigma^0_\oplus$, $P_\ominus$, $P_\oplus$, and $E_{O.C.}$) associated with commercial-grade ZrO_2 + 3 to 4 wt pct CaO electrolytes. Good agreement between experimental and calculated values for the open-circuit cell voltage, $E_{O.C.}$, for relatively high oxygen concentrations in the melt demonstrated that the currently accepted interpretation of electronic conduction in solid electrolytes is valid. In addition, these results provide an experimental verification that n-type electronic conductivity is proportional to $P_{O_2}^{-\frac{1}{4}}$. (auth)

15169 METHOD OF PREPARATION OF NUCLEAR FUEL BODIES. Davis, D. E.; Stevens, D. W.; Tully, G. R. Jr. (to Gulf Oil Corp.). German Patent 1,906,269. 6 Apr 1972. (In German).

A method is described for preparing a solid nuclear fuel body where a chamber having the approximate size and shape of the desired nuclear fuel (e.g., a cavity in a nuclear fuel element part of porous graphite) is used. First, the chamber is fed with the nuclear fuel as loose single particles according to the desired density and then the binder (e.g., heat setting resin) in liquid form under pressure is forced into the chamber in such a manner that the binder flows through the filled particles of nuclear fuel and fills the chamber uniformly, this occupying the vacancies between the fuel particles. The uniform aggregate of fuel particles and binder is then heated in the chamber to harden the binder. Finally, the aggregate undergoes pyrolysis outside the chamber. (GF)

15170 CATALYTIC ACTIVITY OF NEODYMIUM OXIDE. Tosun, Guray; Rase, H. F. (Univ. of Texas, Austin). Ind. Eng. Chem., Prod. Res. Develop.; 11: No. 3, 249-60(1972).

The activity characteristics of neodymium oxide prepared by calcining neodymium hydroxide by use of various atmospheres, calcining temperatures, and pretreatment conditions were studied. Dehydroxylation, which occurs during calcining, followed an inhomogeneous mechanism in which a solid product is produced consisting of pores and regions of topotactically oriented neodymium oxide lattice. With ethanol dehydration as the test reaction, together with extensive measurements of the catalyst before and after treatment, and by use of infrared spectroscopy, x-ray diffraction, and thermal analysis, two apparent types of catalytic sites were identified: oxygen bridges and surface hydroxyl groups, the latter being the major sites for ethanol dehydration. Similarities with alumina were noted which should be pursued for other reactions because of unique differences in atomic sizes and mobility. (auth)

15171 COMPUTATION OF STANDARD PROJECTIONS FOR A TRICLINIC SYSTEM OF ARBITRARY ORIENTATION. Ko, F. Y.; Richman, M. H. (Brown Univ., Providence). Metallography; 5: No. 6, 501-13(Dec 1972).

Equations for the computation of the crystallographic poles in various standard projections are derived for a general triclinic system with the lattice parameters A, B, C, α, β, and γ. The Cartesian coordinates of these projected poles allow precise plotting for arbitrary crystal orientations. As examples the computer simulated orthographic, stereographic, and gnomonic projections for several orientations for WC(c/a + 0.976) and W_2C (c/a + 1.580) are presented. (auth)

15172 HEAT CONDUCTIVITY OF CERMETS CONTAINING TITANIUM CARBIDE. Samsonov, G. V.; Bogomol, I. V.; L'vov, S. N.; Lesnaya, M. I. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 62-65(Nov 1972). (In Russian).

Heat conductivity of cermets of the systems TiC–Nb, TiC–Ta, TiC–Mo, TiC–W containing 28, 50, 75 at % of metal was studied within a temperature range of 20 to 1100°C. A considerable drop is established in heat conductivity coefficient of the cermets in comparison with metals introduced to cermet. A relative rise of the heat conductivity coefficient is shown to take place at constant temperature in a series of the corresponding compositions TiC–Nb, TiC–Ta, TiC–Mo, TiC–W. (auth)

15173 MEASUREMENTS OF EMISSIVITY IN MATERIALS OBTAINED BY MEANS OF POWDER AND PLASMA METALLURGY METHODS. Smirnov, E. V. Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 79-84(Nov 1972). (In Russian).

Methods to investigate thermal emissivity of ceramics, carbides and their mixtures with metals obtained by hot pressing and plasma spraying in vacuum of 1×10^{-5} torr are described. Experimental results are also presented on Al_2O_3, Fe_2O_3, ZrO_2, Si, mechanical mixtures of BeO with Mo and Nb with Cu. (auth)

15174 POROSITY CHANGES IN SINTERED URANIUM DIOXIDE IN THE FINAL STAGE OF SINTERING. Landspersky, Hanus (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 19: No. 1, 11-16(Jan 1973).

The changes in porosity in sintered dense uranium dioxide were studied at porosities ≷5% at temperatures between 1700 and 2200°C in the connection with grain growth with respect to the study of postirradiation behavior of ceramic nuclear fuels. Porosity decrease in the whole temperature region was observed that proceeded via the decrease in the number of smaller pores and in the increase in the number of larger pores without any sample volume increase (solarization). The comparison of the rates of these processes shows that both the pore capture and their coalescence on grain boundaries takes place with their simultaneous motion with the grain boundaries as well as the porosity elimination resulting from the lattice diffusion of vacancies from pores to grain boundaries. The temperature when discontinuous grain growth starts and calculated according to Kuczynski from the equation $T_S = 0.7\ T_m$ is only a rough estimate determining the point when the rate of discontinuous grain growth in the total sample reaches high value. (auth)

15175 FAST-NEUTRON DAMAGE TO POLYCRYSTALLINE ALUMINA AT TEMPERATURES FROM 60 TO 1230°C. Keilholtz, G. W.; Moore, R. E.; Robertson, H. E. (Oak Ridge National Lab., TN). Nucl. Technol.; No. 3, 234-246 (Mar 1973).

The effects of fast neutrons on four commercial polycrystalline alumina products of high density were investigated. These materials have been considered for use as electrical insulators in nuclear-powered thermionic converters. Fast-neutron fluences up to 8.4×10^{21} neutrons/cm^2 (>0.1 MeV) were achieved; irradiation temperatures ranged from 60 to 1230°C. Neutron damage was manifested by gross fracturing, volume increase, and separation at grain boundaries. There was very little damage at temperatures below 100°C, but it was much greater at temperatures from 570 to 1070°C (the temperature range for thermionic applications). At 1100°C and above, in-reactor thermal annealing was rapid enough to reduce damage effects significantly, but increased damage occurred to specimens irradiated at much higher temperatures (~1230°C). Based on the irradiation results, the following conclusions and recommendations were made for the use of polycrystalline alumina in thermionic converters: (1) the alumina should be of high purity to minimize gross fracturing, and it should be of small grain size to minimize the effects due to separation at grain boundaries, (2) the thermionic device should be designed for continuous operation because thermal cycling apparently promotes separation at grain boundaries, (3) the design should allow for an increase in volume of the alumina insulators of about 3%, and (4) alumina of high purity and small grain size can withstand fast neutron fluences up to about 4.3×10^{21} neutrons/cm^2 in an ETR type neutron spectrum and up to about 2.8×10^{21} neutrons/cm^2 in an EBR-II type spectrum for those neutrons with energies greater than 0.1 MeV. (auth)

15176 THERMAL CONDUCTIVITY OF TWO-PHASE SOLID BODIES. Stora, J. P. (CEN, Grenoble, France). Nucl. Technol.; 17: No. 3, 225-233(Mar 1973).

A survey has been made of equations for calculating the thermal conductivity of two-phase solid bodies based on Ohm's law and the flux laws. Most of these equations can be reduced to the Fricke relationship for a two-phase medium containing the second phase as randomly distributed ellipsoids. Fricke's relationship is applied to porous uranium dioxide and to cermets UO_2–metal with a structural orientation. In the case of UO_2, Loeb's formula based on Ohm's law, is considered. Although physically inadequate, this formula is easily handled and used by most investigators: the thermal conductivity of UO_2 is corrected by introducing an empirical factor α multiplying the whole porosity of the oxide; α is generally determined by experimental measurements. The probable value for α is 2.3 ± 0,5. By using the Fricke equation the α factor is justified and calculated. The thermal conductivity of UO_2–Fe, and UO_2–Ni, containing 10, 20 and 30% metal by weight, is calculated, according to the parallel and perpendicular direction of "metallic veins," using the Fricke mixture equation. The calculated values are compared with the experimental thermal diffusivity data measured along the two previous directions. The Fricke two-phase equation is found not to agree experimentally, especially at low temperature. This discrepancy is probably due to the insufficiently precise mathematical formulation. (auth)

Metals and Alloys

Refer also to abstracts 14516 and 14669.

15177 GIORNATE DELL'ENERGIA NUCLEARE 1970. ASPETTI MECCANICI E COSTRUTTIVI DELLA TECNICA NUCLEARE. (Nuclear Energy Conference 1970. Mechanical and Constructional Aspects of Nuclear Technology). Proceedings of Conference Held at Milan, Italy, December 10–12, 1970. Serie Simposi. Rome; Comitato Nazionale Energia Nucleare (1972). 616p. (CONF-701231).

Twenty of the twenty-five papers presented at the symposium are abstracted. The papers deal with structural materials, plant components, construction techniques, and instrumental technology of nuclear reactors. The symposium closed with a panel discussion on the "Effect of Nuclear Energy on Technological Development." This discussion is presented in full. (JSR)

For abstracts of individual papers see: 14652, 14665–14667, 14938, 14939, 15178, 15188, 15189, 15203–15206, 15277, 15318, 16524, 16565, 16566, 16592, and 16593.

15178 MW6: AN ARC WELDER FOR MICROWELDS. Pitimada, D. pp 359-70 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The characteristics of the MW6, a tungsten inert gas-type welder, are discussed. An example is given of its use in the execution of hot joints of clad microthermocouples and in the welding of a stainless steel belt on small-diameter clad thermocouples. (JSR)

15179 METALLURGICAL APPLICATIONS OF THE MOESSBAUER EFFECT. Flinn, P. A. (Carnegie-Mellon Univ., Pittsburgh). pp 123-34 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Most of the practical applications of the Moessbauer effect in metallurgy are essentially analytical in nature, and rather similar to those of x-ray diffraction. It can be used for such purposes as the determination of the mineral constituents of ores, the determination of phase diagrams, studies of the kinetics of phase transformation, determination of the amounts of various phases present in polyphase mixtures, determination of the compositions of various phases in polyphase systems. It can also be used for certain special purposes, such as the study of certain defect phenomena, and measurement of diffusion coefficients. In virtually all applications it has the advantage of being a nondestructive technique. In many applications where it is essentially competitive with x-ray diffraction it has at least the prospect of providing some or all the advantages of greater accuracy, greater convenience, and shorter time required for measurement. A complete summary of all possible practical applications in the metallurgical industry, is not given, however, some of the capabilities of the technique are presented. The need for a nondestructive analytical technique arises in innumerable circumstances, and, as the advantages of Moessbauer spectroscopy become better established and more widely known, an increasing variety of applications may be expected. (RCK)

Corrosion and Erosion

Refer also to abstracts 16514 and 16525.

15180 STRESS-CORROSION CRACKING OF ZIRCALOY-2 IN METHANOL–IODINE SOLUTIONS. Elayaperumal, K.; De, P. K.; Balachandra, J. (Bhabha Atomic Research Centre, Bombay). J. Nucl. Mater.; 45: No. 4, 323-330(Jan 1973).

Annealed Zircaloy-2 cracks intergranularly when uniaxially stressed in boiling methanol–iodine solutions containing 0.002 to 20.0 g I_2/l. The time to failure decreases with increasing iodine concentration. Stressing to 75% of the 0.2% proof-stress increases the dissolution rate by about 20 times. Both the corrosion rate and the time to failure under stress are independent of impressed electrochemical potential. The activation energy for dissolution, 8350 cals/mole for the unstressed condition, is reduced to 3360 cals/mole under applied stress. This activation energy probably corresponds to the adsorption of I_2 on the Zircaloy surface. The mechanism of the stress-corrosion cracking seems to be one of stress-assisted dissolution controlled by the adsorption of I_2. (auth)

15181 ACCELERATED OXIDATION NEAR ZIRCALOY WELDS. Garlick, A. (United Kingdom Atomic Energy Authority, Sellafield, Eng.). J. Nucl. Mater.; 45: No. 4, 332-334(Jan 1973).

Oxygen dissolution from zirconium oxide autoclaved layers during tungsten-inert gas welding of Zircaloy may lead to a more rapid rate of oxidation in the weld heat-affected zones during subsequent exposure to corrosive conditions. However, this rate

might be expected to decrease to a value more typical of standard Zircaloy once the oxygen-rich regions are completely oxidized. (auth)

15182 OXIDATION OF TUNGSTEN AND MOLYBDENUM IN OXYGEN ATMOSPHERE AT LOW PRESSURES AND HIGH TEMPERATURE. Wahl, G. (Brown Boveri and Cie AG, Mannheim, Ger.). Z. Naturforsch.; 27a: No. 12, 1741-51(Dec 1972). (In German).

The oxide evaporation of Mo and W (polycrystalline and 110-oriented) in oxygen ($2 \cdot 10^{-6}$ to $6 \cdot 10^{-6}$ torr) at 1900°K was investigated. Two parallel discs were operated in an oxygen atmosphere. One of these discs (an emitter of Mo or W) was kept at 1900°K, the other one (collector) at 1000°K. During operation, oxides of the emitter material were formed on the emitter surface, evaporated, and condensed on the collector. The oxide profile on the collector was measured by microprobe. The profile allowed the determination of $W_M = j_M/j_E$ and $W_{tot} = j\ (O_2 \text{ in oxides})/j_E$. j_M: evaporation density of W or Mo atoms bound in oxides; $j\ (O_2 \text{ in oxides})$: evaporation density of oxides of emitter metal and impurities (in O_2-units); j_E: impingement density of O_2-molecules. Calculations used to determine W_M and W_{tot} are described. The measurements gave the following values for W_M and W_{tot}: tungsten, polycrystalline: $W_M = (7 \pm 1)\%$; $W_{tot} = (8.5 \pm 1)\%$; tungsten, 110-oriented: $W_M = (2 \pm 0.5)\%$; $W_{tot} \approx 2\%$; and molybdenum, polycryst.: $W_M = (37 \pm 2)\%$; $W_{tot} = (42 \pm 4)\%$. (auth)

15183 INFLUENCE OF TEMPERATURE VARIATIONS ON THE OXIDATION BEHAVIOR OF ZIRCONIUM: COMPARISON WITH COBALT. Com-Nougue, J. (Ecole Nationale Superieure des Mines, Paris); Morin, F.; Beranger, G.; Lacombe, P. Werkst. Korros.; 23: No. 9, 779-84(1972). (In French).

Temperature variations produced during the oxidation of a metal have an influence on oxidation kinetics depending on the particular metal. This influence is discussed for the case of zirconium and was compared with the observations made on cobalt, because the two metals behave differently. An abrupt temperature decrease during the oxidation of zirconium yielded a pronounced acceleration of the oxidation. In the case of cobalt, however, the influence of such a temperature change on the ultimate oxidation rate was negligible. These results are discussed in terms of the relative plasticities of oxide and metal. (GF)

15184 DEOXIDATION OF VANADIUM BY CALCIUM, BARIUM, AND MAGNESIUM. Peterson, D. T.; Clark, R. G.; Stensland, W. A. (Ames Lab., Iowa). J. Less-Common Metals; 30: 169-72(1973).

Studies were made on the oxygen content of V equilibrated with alkaline earth metals (Ba, Ca, and Mg) using massive V samples to reduce the surface area and a fast neutron activation analysis method that was quite sensitive and accurate, even at low oxygen contents. The observed oxygen contents were very low but were all somewhat higher than the calculated values. Several possible explanations for observing a higher than predicted oxygen content in the Ca/CaO and Mg/MgO samples are discussed. (PCH)

15185 EARLY STAGES OF ZIRCONIUM OXIDATION. Srivastava, L. P. (Punjab Engineering Coll., Chandigarh, India); Archbold, T. F. J. Nucl. Mater.; 45: No. 3, 258-60(Dec 1972).

It has been found previously that electropolished polycrystalline Zr exhibits a transition from a rapid to a slower parabolic rate at an oxide thickness corresponding to a weight gain of approximately 1 mg/dm^2. In work by Dawson, Baugh, and White (Electrochem. Technol. 4, p. 137 (1966)) it was indicated that this transition may occur at greater values of the weight gain with increasing temperature. Evidence is now given to show that the weight gain at this transition does increase with temperature, ranging from ~1 mg/dm^2 at 440°C to ~30 mg/dm^2 at 850°C. Also, a decrease in the oxygen pressure decreases the weight gain at the transition for a given temperature in the range 650 to 800°C. (PCH)

15186 EFFECT OF A HYDROGEN PREHEAT-TREATMENT ON THE OXIDATION BEHAVIOR OF Ni–Cr–Al–ThO_2 ALLOYS. Baranow, S. (Fansteel Inc., Baltimore). Met. Trans.; 3: No. 12, 3265-7(Dec 1972).

A method whereby the oxidation resistance of the Ni–Cr–Al–ThO_2 alloy is further improved without recourse to coating for use in space shuttles is described. In an attempt to suppress or eliminate Cr_2O_3 formation, specimens of varying Al content (2 to 4%) were subjected to a 2150°F, preoxidation heat-treatment in H_2 of a –70°F dewpoint. Since this environment is reducing with respect to Cr_2O_3 and NiO_3 thin (approximately 0.03 mil) Al_2O_3 films were formed on the surfaces of those specimens. Subsequent static and cyclic oxidation tests showed that a preformed Al_2O_3 scale will persist or be overgrown by $NiAl_2O_4$ for at least 2200°F if the aluminum content is a minimum of 3%. The hydrogen pretreated specimens developed only a thin surface layer of Al_2O_3 or Al_2O_3 + $NiAl_2O_4$ in all tests. Under static conditions at 1800 and 2300°F both Cr_2O_3 and Al_2O_3 were formed with as-received material. In the dynamic test at 2200°F, the as-received specimen had predominantly $NiAl_2O_4$ and NiO on the face directed toward the gas stream and Cr_2O_3 on the back face. Thus the beneficial effect of the hydrogen preheat-treatment was quite obvious. (PCH)

15187 OXIDATION OF Na_2O_4 COATED Ni–20Cr–$2ThO_2$. Davis, H. H.; Graham, H. C.; Uhlig, G. F. (Aerospace Research Labs., Wright Patterson AFB, OH). Met. Trans.; 3: No. 12, 3247-57(Dec 1972).

The Na_2SO_4-induced oxidation of Ni–20Cr–$2ThO_2$ has been studied at 900 and 1000°C in 150 torr O_2. A rapid weight-gain period, corresponding to NiO formation, occurred after a short incubation period. The duration of the rapid weight gain stage persisted for about 2 h and terminated with the development of a continuous Cr_2O_3 internal layer. Subsequent oxide formation was extremely slow, similar to that reported for normal oxidation of TD–NiCr. (auth)

15188 ZIRCONIUM ALLOYS IN NUCLEAR TECHNOLOGY. Scaroni, A. (CISE, Milan). pp 53-76 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The characteristics of the primary Zr alloys used in nuclear technology are examined. The review shows that the use of Zircaloy as cladding material for fuels of water reactors has been amply tested and has proved satisfactory. The parameter limiting its use appears to be in the majority of cases the absorption of H_2. The use of Zr-2.5% Nb has some advantages, but presents some problems as for example the behavior of the zone altered by welding. The use of Zircaloy as pressure tube material has been satisfactory. The use of Zr-2.5% Nb shows significant advantages. Promising alloys for use at high temperatures, either in water or organic liquids, were also reviewed. (JSR)

15189 USE OF ALLOYS WITH HIGH NICKEL CONTENT IN NUCLEAR PLANTS. Galletto, M.; Portisch, H. (Nickel Alloys International SA, Milan). pp 77-89 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The behavior of alloys with high nickel contents with respect to corrosion under stress and to corrosion by liquid sodium is discussed. The quantities of these alloys used in the principal types of reactors are briefly indicated. (JSR)

15190 MECHANISMS FOR THE HOT CORROSION OF NICKEL-BASE ALLOYS. Goebel, J. A. (Pratt and Whitney Aircraft, Middletown, CT); Pettit, F. S.; Goward, G. W. Met. Trans.; 4: No. 1, 261-78(Jan 1973).

The Na_2SO_4-induced accelerated oxidation of nickel-base alloys containing elements such as Cr, Al, Mo, W, and V has been studied in 1.0 atm O_2 in the temperature range of 650 to 1000°C. It has been found that the hot corrosion behavior of these alloys can usually be characterized according to one of two types of attack: Na_2SO_4-induced accelerated oxidation; or Na_2SO_4-induced catastrophic oxidation. In both types of hot corrosion, accelerated oxidation occurred as a result of the formation of a liquid flux based on Na_2SO_4 which dissolved the normally protective oxide scales. Catastrophic, or self-sustaining rapid oxidation can occur in alloys which contain Mo, W, or V, because solutions of oxides of these elements with Na_2SO_4 decrease the oxide ion activity of the molten salts, producing melts which are acidic fluxes for oxide scales. The accelerated oxidation type of attack which was observed with most alloys which did not contain Mo, W, or V, was more severe than for normal oxidation, but much less severe than catastrophic oxidation. Na_2SO_4-induced accelerated oxidation occurred because the oxide ion activity of the Na_2SO_4 increased to the point where oxide scales can partially dissolve in the basic melt. Generally, this basic fluxing resulted from the diffusion of sulfur from the Na_2SO_4 into the alloy. In some alloys, the formation of sulfides during basic fluxing was a sufficient condition to cause accelerated oxidation. In other alloys, changes in the oxidation mechanism occurred because of depletion of the alloy surface, concomitant with basic fluxing, of these elements needed for protective oxide scales, such as aluminum and chromium. (auth)

15191 ELECTROCHEMICAL DEOXIDATION OF INDUCTION-STIRRED COPPER MELTS. Oberg, K. E. (Hogskolan Inst., Stockholm); Friedman, L. M.; Boorstein, W. M.; Rapp, R. A. Met. Trans.; 4: No. 1, 75-82(Jan 1973).

Induction-stirred melts of copper contained in zirconia-base electrolyte crucibles were deoxidized by electrochemical pumping of oxygen. The rate-controlling step for the deoxidation reaction was found to be transport of oxygen in the electrolyte in the higher oxygen concentration ranges, and transport across a boundary layer in the melt at the melt/electrolyte interface for the lower concentration ranges. The mass transfer coefficient for transport of oxygen across the boundary layer at the melt/crucible interface was determined to be $\alpha\delta^{u} = 1.7 \cdot \exp(-12{,}900/RT)$ cm/s. The optimization of the experimental parameters for this new deoxidation method is discussed. (auth)

15192 HIGH TEMPERATURE BEHAVIOR OF SUPERALLOYS EXPOSED TO SODIUM CHLORIDE. I. MECHANICAL PROPERTIES. Paton, N. E.; Robertson, W. M.; Mansfeld, F. (North American Rockwell Science Center, Thousand Oaks, CA). Met. Trans.; 4: No. 1, 317-20(Jan 1973).

An investigation of the corrosion behavior of superalloys in the presence of sodium chloride at elevated temperatures has been conducted and the effects of corrosion on mechanical properties investigated. Residual mechanical properties as determined by a postexposure tensile test were found to be seriously degraded, the amount of degradation being dependent upon the partial pressure of oxygen in the environment. Creep rates were increased by as much as three orders of magnitude in the presence of NaCl. (auth)

15193 HIGH TEMPERATURE BEHAVIOR OF SUPERALLOYS EXPOSED TO SODIUM CHLORIDE. II. CORROSION. Mansfeld, F.; Paton, N. E.; Robertson, W. M. (North American Rockwell Science Center, Thousand Oaks, CA). Met. Trans.; 4: No. 1, 321-7(Jan 1973).

The corrosion behavior of various superalloys in molten NaCl has been examined by weight loss measurements, analysis of corrosion products, and potentiostatic polarization curves. Corrosion rates were higher in platinum than in quartz crucibles, relatively independent of alloy composition, but highly dependent on oxygen pressure. The high corrosion rates and the shape of the polarization curves indicate that the oxides formed in molten NaCl are not protective. Analysis of the sodium content in the alloy after exposure to molten NaCl indicates diffusion of sodium into the bulk of the metal. The effect of oxygen and the higher corrosion rates in platinum crucibles are explained by thermodynamic and kinetic considerations. (auth)

15194 STRAIN/OXIDATION INTERACTIONS IN STEELS AND MODEL ALLOYS. Holmes, D. R.; Pascoe, R. T. (Central Electricity Research Labs., Leatherhead, Eng.). Werkst. Korros.; 23: No. 10, 859-70(1972).

The strains generated in oxide films on a number of materials of interest to the power generation industry are considered in relation to their operating conditions. Topics discussed include the growth of nuclear canning alloys, oxide spalling, the formation of multilayer oxides during internal boiler corrosion and low ductility failures in austenitic stainless steels. The strains induced during thermal cycling are considered in detail and the temperature changes required to cause film cracking are estimated and compared with observed spalling behavior. (GF)

15195 INVESTIGATION OF STRESS CORROSION CRACKING SUSCEPTIBILITY OF Fe–Ni–Cr ALLOYS IN NUCLEAR REACTOR WATER ENVIRONMENTS. Clarke, W. L.; Gordon, G. M. (General Electric Co., Pleasanton, CA). Corrosion; 29: No. 1, 1-12(Jan 1973).

Nonstabilized 300 series stainless steels stressed over yield are susceptible to intergranular stress corrosion cracking (SCC) when exposed in the heavily sensitized condition to 288°C high-purity water containing dissolved oxygen. The effects of stress, oxygen levels, and significant metallurgical parameters on intergranular SCC of AISI Type 304 are being evaluated. Several promising intergranular SCC-resistant alternate alloys have been identified through preliminary investigations, e.g., austeno–ferritic duplex and stabilized austenitic stainless steels. (auth)

Preparation and Fabrication

Refer also to abstracts 14636 and 14986.

15196 (ANCR-1087) METALLURGICAL EVALUATION OF WELDING AND HEAT TREATING PROCEDURES FOR THE INCONEL 718 PBF IN-PILE TUBE. Graber, M. J.; Brinkman, C. R.; Hobbins, R. R. (Aerojet Nuclear Co., Idaho Falls, Idaho). Oct 1972. Contract AT(10-1)-1375. 57p. Dep. NTIS.

Problems were encountered during welding and heat treating qualification testing and fabrication of the Power Burst Facility in-pile tube which was made of Inconel 718. Areas of localized low ductility in the welds were detected by bend testing. Solution heat treat temperatures high enough to dissolve and redistribute the Laves phase in the welds resulted in inadequate parent metal strength. To solve the problems, the welds were given a higher localized solution heat treatment (1 hour at 2025°F) and the entire assembly was then solution annealed 1 hour at 1925°F and duplex aged, at 1325 and 1150°F, for a total of 42 hours. (auth)

15197 DIFFUSION WELDING OF BERYLLIUM. PART II. THE ROLE OF THE MICROALLOYING ELEMENTS. Bosworth, T. J. (Boeing Co., Seattle). Weld. J. (N. Y.); 52: No. 1, 38s-48s.

Results of a study are discussed that is concerned with the mechanisms of the welding process, and the role of the microalloying elements in weld formation. The test results demonstrate that the formation of a diffusion weld in beryllium is dependent on the precipitation of iron-beryllium compounds at the joint interface and that the welding temperature can change the type and distribution of the microalloying element compounds in the base metal. It was also found that the welding temperature, and post weld thermal processing can have a significant influence on strength and ductility. (J.R.D.)

15198 INFLUENCE OF WELD BEAD AREA ON WELD METAL MECHANICAL PROPERTIES. Shultz, B. L. (American Transportation Corp., Sharon, Pa.); Jackson, C. E. Weld. J. (N. Y.); 52: No. 1, 26s-37s(Jan 1973).

Variations in welding conditions have been known to influence the properties of weld deposits by their effect on the transformation and solidification processes for weld metal. These changes occur during the cooling portion of the weld thermal cycle; thus, it is important to know the cooling rates of weld metal in order to adequately describe its response to the welding process. In the past, the heat source for calculating weld metal cooling rates has been measured by the parameters of the welding arc; this heat input has been calculated in units of joules or watt-seconds per unit length of weld. Recently it has been proposed that the calorific heat content of the weld metal is a more appropriate source for determining weld metal cooling rates. The calorific heat content is dependent upon the volume of molten weld metal and is proportional to the weld metal area. In this investigation the calorific heat content of a unit volume of a single weld bead was the basis for measurement. For convenience, such unit volume has been termed "nugget" volume, and its cross-sectional area "weld nugget area." A working relationship between multi-pass shielded metal-arc weld metal mechanical properties and the weld nugget areas for high strength steel is described. The effect of weld nugget area on weld metal cooling rates and the effects of variations in welding technique on resultant weld nugget areas are also presented. A unique cooling rate has been obtained for each combination of preheat and weld nugget area. Weld metal cooling rates and welding energy inputs are also investigated for possible relationships to mechanical properties. (auth)

15199 WELD METAL PROPERTY SELECTION AND CONTROL. Heuschkel, J. (Westinghouse Electric Corp., Pittsburgh). Weld. J. (N. Y.); 52: No. 1, 1s-25s(Jan 1973).

Fabricators can at present choose between at least six different shielded-arc processes. As-deposited steel welds may have tensile yield strengths between 38,000 and 207,000 psi, depending upon filler metal and process selection. Heat-treated welds may be even stronger. As-deposited tensile elongation values may range up to 50%, area reduction values up to 80%, and Charpy V-notch energy values up to 240 ft-lb. The multiple choices of filler metals, processes, and properties available challenge the designer and fabricator to select the technically most appropriate and the finally most economical filler metal-process-property combination for any specific weldment. (auth)

15200 ENHANCEMENT OF MACHINABILITY OF MATERIALS THAT ARE DIFFICULT TO WORK. Finkelnburg, H. H. Metall; 26: No. 10, 1018-25(Oct 1972). (In German).

A drastic enhancement of cutting speed in the machining of hard materials is discussed. Especially developed machines permit cutting speeds from 5000 m/minute to 50,000 m/minute. Modern construction materials are surveyed and experimental results and limitations of hot machining are discussed. Electrical procedures for spark erosion, electrolytic shaping, and etching are summarized. Grinding is also briefly discussed. (HBG)

15201 GROWTH OF NIOBIUM ON PERFECT AND IMPERFECT SAPPHIRE. Cuomo, J. J.; Angilello, J. (IBM Watson Research Center, Yorktown Heights, NY). J. Electrochem. Soc.; 120: No. 1, 125-8(Jan 1973).

Niobium prepared by rf sputtering has been found to nucleate and grow differently on the basal plane of low dislocation density (chemical vapor deposited) and high dislocation density (Czochralski-grown) sapphire (α-Al_2O_3) wafers. The low dislo-

cation α-Al_2O_3 showed three different orientations related to each other by a threefold axis: (110) Nb//(0001) α-Al_2O_3 and [110] Nb//$\vec{a}_1$, $\vec{a}_2$, $\vec{a}_3$ α-Al_2O_3, while those films grown on more imperfect, high dislocation substrates, generally showed only one orientation: (111) Nb//(0001) α-Al_2O_3 and [110] Nb//[1120] α-Al_2O_3. (auth)

15202 ANODIC SECTIONING OF VANADIUM. II. STUDIES ON ANODIC SECTIONING. Arora, M. R.; Kelly, R. (McMaster Univ., Hamilton, Ont.). J. Electrochem. Soc.; 120: No. 1, 128-33(Jan 1973).

Anodic sectioning can be accomplished with vanadium almost as readily as with Al, Mo, and W, the main problem being the instability of the anodic film. The basic technique consists of forming films in an electrolyte based on acetic acid (as was shown possible by Keil and Salomon) and then removing the films with aqueous KOH. The thickness calibrations were obtained separately for high and low sectioning voltages, the results for high voltages being as follows: total metal removed in units of $\mu g/cm^2$ equal to 5.5 + 0.64 × volts (for voltages ≥ 4); thickness of oxide in units of $\mu g/cm^2$ equal to 2.0 + 1.14 × volts (for voltages ≥ 7.5). Particular attention was paid to extending the calibrations to low sectioning voltages. In the case of the oxide thickness, the approach used can be regarded as an alternative to ellipsometry, being based on a three-step procedure in which a film is formed, 20 or 40-keV ^{85}Kr ions are implanted, and the film is stripped with aqueous KOH. The fraction of the ^{85}Kr activity which is transmitted can be shown, using amorphous stopping theory, to give direct information on the film thickness. The low-voltage calibrations were as follows: total metal removed in units of $\mu g/cm^2$ equal to 1.0 + 1.78 × volts; thickness of oxide in units of $\mu g/cm^2$ equal to −5.1 + 2.09 × volts. (auth)

15203 DEVELOPMENT OF ELECTROSLAG WELDING OF LOW-ALLOY AND STAINLESS STEELS IN THE FABRICATION OF VERY THICK COMPONENTS OF NUCLEAR INSTALLATIONS. Frigerio, G. pp 337-58 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The three phases in the development of electroslag welding are summarized. The first phase is the development of the welding procedure, both vertically and circumferentially, and preliminary evaluation of the chemical-metallurgical characteristics of the joint. In the second phase the possibilities offered by thermal treatment of the welded seams were examined with particular attention being given to the partial austenitization treatment on a typical low-alloy steel. The characteristics of the electroslag welded seams were studied with emphasis on their corrosion resistance. (JSR)

15204 ZIRCONIUM ALLOY WELDING TECHNIQUES DEVELOPED AND USED BY THE CNEN. Fizzotti, C.; Gabaglio, M. pp 371-97 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The welding and brazing techniques and apparatus developed for the welding of zirconium alloys are described. The welding techniques used are welding in inert gas with non-consumable electrode, electron bombardment welding, and resistance welding. The weld characteristics desired according to the use are discussed. The control methods used are described. (JSR)

15205 STEEL–ZIRCONIUM METALLURGICAL AND MECHANICAL JOINTS. Boccalari, M. (CNEN, Saluggia, Italy); Liscia, A.; Brutto, E. pp 399-422 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The design criteria, fabrication procedures, and quality control were reported and discussed for the development of mandrelled couplings of the conventional type and of the sandwich type for the power channel, development of co-extruded couplings for the tubing of the control system (biphase rods), and development of co-extruded couplings for the power channels. (JSR)

15206 EXPLOSIVE WELDING. Albertini, C.; Golinelli, P.; Montagnani, M.; Verzelletti, G. (CCR-EURATUM, Ispra, Italy). pp 423-34 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The application of the explosive welding technique to steel-zirconium couples of the pressure tube in heavy water reactors and to the cap-cladding welding of fuel elements for sodium-cooled fast reactors is described. Destructive and non-destructive controls of the cap-cladding welds are discussed. The economic factors of explosive welding are considered. (JSR)

15207 PREPARATION OF HIGH-PURITY VANADIUM BY MAGNESIUM REDUCTION OF VANADIUM DICHLORIDE. Campbell, T. T. (Albany Metallurgy Research Center, OR); Schaller, J. L.; Block, F. E. Met. Trans.; 4: No. 1, 237-41(Jan 1973).

High-purity vanadium was made by magnesium reduction of vanadium dichloride. Procedures used included: the preparation of vanadium tetrachloride by chlorination of partially reduced vanadium oxide-carbon briquets; rechlorination of crude vanadium tetrachloride containing oxychloride compounds; thermal decomposition of vanadium tetrachloride to vanadium trichloride; hydrogen reduction or thermal disproportionation of vanadium trichloride to vanadium dichloride; magnesium reduction of vanadium dichloride to vanadium sponge; and consolidation of vanadium sponge to metal by arc-melting. It was found that higher yields of high-quality vanadium metal can be prepared by reduction of vanadium dichloride than can be prepared from trichloride. Metal of >99.8% purity was prepared by magnesium reduction of vanadium dichloride with reaction efficiencies approaching 98%. Only minor losses of vanadium are experienced because of the high efficiencies of the individual process steps and because of the potential for recycling process streams. (auth)

15208 DISPERSION-STRENGTHENED ZIRCONIUM PRODUCTS AND A PROCEDURE FOR FABRICATION OF SAME. Adolph, E.; Balling Jensen, J. C.; Hansen, N.; (and others) (to Danish Atomic Energy Commission). Danish Patent 431,870. 15 May 1972. Filed 21 Aug 1970. (In Danish).

A procedure is described for fabrication of dispersion-strengthened zirconium products containing fine metal oxide particles dispersed in a zirconium or zirconium alloy matrix. Zirconium or zirconium alloy in a hydrated, powered condition is mixed intimately with yttrium oxide, magnesium oxide, cerium oxide, or beryllium oxide powder with a very small average particle size. The mixture is heated in vacuum until expulsion of hydrogen and simultaneous or subsequent sintering in a compressed condition at a temperature below 800°C and preferably below approximately 750°C is reached. (Denmark)

15209 WORKPIECE MADE OF NIOBIUM OR NIOBIUM-BASE ALLOY WITH A PROTECTIVE COATING AND METHOD OF ITS PREPARATION. Priceman, S.; Sama, L. (to Trefimetaux). German Patent 1,902,604. 26 Aug 1972. (In German).

A description is given of the production of a workpiece made of niobium or an alloy containing at least 45% niobium with an oxidation-resistant coating made of an alloy of 40 to 85% silicon, 10 to 40% chromium, and 5 to 40% iron. (GF)

15210 TRANSFER OF NUCLEAR HEAT TO REDUCTION PROCESSES FOR IRON PRODUCTION. Reichenbach, Bernd. VDI (Ver. Deut. Ing.) Z.; 114: No. 16, 1177-1183(Nov 1972). (In German).

The nuclear power plant, as part of an integrated steel works, will play a major role in future metallurgical engineering. A particular importance in this respect is attached to the utilization of the thermal energy produced in the nuclear reactor for the recovery of iron from ores without a previous conversion of the thermal energy into electric energy. Such an application has been made possible by using indirect heat transfer. The development of a silicon tube heat exchanger which has proved suitable for temperatures up to 1200°C and pressures up to 50 bars is discussed. (auth)

15211 BORATING OF COBALT AND SOME ALLOYS ON ITS BASE. Zhunkovskii, G. L.; Navrotskii, B. S.; Kolosvetov, Yu. P. (Kiev Polytechnic Inst.). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 33-35(Nov 1972). (In Russian).

The possibility for increasing the hardness of a cobalt component in a hard alloy was studied by means of chemico-thermal treatment. Borating of pure cobalt and its alloys with 2 to 20% WC is shown to result in a hardness increase to 1100 kg/mm^2. (auth)

15212 UTILIZATION OF DETONATION PHENOMENON FOR APPLYING COATINGS. Zverev, A. I.; Miroshnichenko, I. Yu. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 36-47(Nov 1972). (In Russian).

A critical review of a modern state in operations on the detonation method for applying coatings is presented. Detonation coatings are shown to be widely used for protecting machine parts,

tools and equipment in many branches of industry. Characteristics of mixtures and materials used in the detonation method of applying coatings are presented; their properties and ranges of application are indicated. (auth)

15213 MULTIBEAM-ION SPUTTERING APPARATUS FOR PRODUCING THIN HOMOGENEOUS OR ALLOYED FILMS. Fiedler, O.; Reisse, G. (to VEB Elektromat). British Patent 1,295,465. 8 Nov 1972. Filed date 11 Nov 1969. 8p.

Disadvantages of existing apparatuses for ion sputtering are described. The apparatus described comprises a vacuum system containing one or more discharge systems for sputtering either by the plasma process or ion beam process. A number of ionization chambers are provided in the housing of each discharge system, with an extractor electrode system comprising a counter cathode, an extractor electrode and a protection electrode situated downstream. A number of beams can be produced by the apparatus. The electrode assemblies of the ionization chambers may be of Penning type. (UK)

Properties, Structure, and Phase Studies

Refer also to abstracts 14701, 14969, 15166, 15215, 16009, 16443, 16450, and 16816.

15214 (AI-AEC-13047) SURVEY OF HELIUM EMBRITTLEMENT OF VARIOUS ALLOY TYPES. Kramer, D.; Garr, K. R.; Pard, A. G.; Rhodes, C. G. (Atomics International, Canoga Park, Calif.). 8 Dec 1972. Contract AT(04-3)-824. 22p. Dep. NTIS.

The effects of helium on the uniform and total elongation, at 700°C, of alloys from different classes, were investigated using helium-injected miniature tensile samples. These alloys consisted of simple austenitic stainless steels, austenitic stainless steels with added titanium, nickel-base alloys, and ferritic stainless steels, plus others. The total elongation of every alloy except TZM was reduced by helium whereas uniform elongations suffered little or no reductions in many cases. The alloys with the best ductility in the presence of helium were Type 316H stainless steel (high carbon) and 12R72. (auth)

15215 (EURISOTOP-59) TECHNOLOGICAL AND ECONOMIC IMPORTANCE OF THE DETERMINATION OF OXYGEN IN NON-FERROUS METALS. Kraft, G. (European Atomic Energy Community, Brussels (Belgium). Bureau Eurisotop). Apr 1972. 49p. (In French). Dep. NTIS (U. S. Sales Only)

The effects of oxygen in non-ferrous metals are outlined. The metals discussed are copper and its alloys, lead and its alloys, aluminum and its alloys, titanium, zirconium, vanadium, niobium, tantalum, molybdenum, tungsten, germanium, silicon, selenium, and the alkali metals. In Ti, O acts as a dissolved metal and affects the hardness, elasticity limit, and resistance to tension. Zr behaves almost exactly as Ti and O behaves as an alloying element which reenforces the qualities of resistance. As in the case of Ti and its alloys, the effects of O on the qualities of resistance decrease sharply as a function of temperature increase. O affects the ductile/fragile transition temperature in V and the hardness. Nb and Ta possess a strong affinity for O, which exerts a strong influence on the mechanical properties. The presence of even low amounts of O cause Mo and W to become so fragile that their fabrication is difficult. The economic importance of the determination of O in these metals is discussed. (JSR)

15216 (HSSTP-TR-22) TESTS OF 6-INCH-THICK FLAWED TENSILE SPECIMENS. THIRD TECHNICAL SUMMARY REPORT: LONGITUDINAL SPECIMENS NUMBERS 14 THROUGH 16; UNFLAWED SPECIMEN NUMBER 17. Grigory, S. C. (Southwest Research Inst., San Antonio, Tex.). Oct 1972. Subcontract 3202. 64p. Dep. NTIS.

For Oak Ridge National Lab., Tenn.

Data from tensile tests of 6-in.-thick longitudinal specimens machined from Type A533B steel are presented. Flawed specimens were tested to failure at −40 to 200°F. Unflawed specimens were tested at 200°F. Data on strain are included tabularly along with clip gage data. (JRD)

15217 (HSSTP-TR-24) TESTS OF 6-INCH-THICK TENSILE SPECIMENS. FIFTH TECHNICAL SUMMARY REPORT: ACOUSTIC EMISSION MONITORING OF ONE-INCH-THICK AND SIX-INCH-THICK TENSILE SPECIMENS. Ying, S. P.; Grigory, S. C. (Southwest Research Inst., San Antonio, Tex.). Nov 1972. Subcontract 3202. 40p. Dep. NTIS.

For Oak Ridge National Lab., Tenn.

Results of tensile tests by acoustic emission on 1-in.- and 6-in.-thick flawed specimens of A533B steel are reported. Results showed that the acoustic emission increased before the yield point of the material and reached a plateau near the yield point. The emission increased again prior to failure. The rate of change of emission with respect to the strain prior to yielding depends on the test temperature. The rate of emission from the base metal was greater the higher the test temperature. During the few steps at the beginning of the tensile tests, the acoustic emission stopped when the tensile machine was stopped to record strain data; however, the emissions continued after the tensile machine was stopped when the stresses were near and beyond the yield point. This was probably due to an increase in strain at constant load, a phenomenon observed during these tests. The emission counts obtained from a six-inch-thick specimen were greater than that from a $\frac{1}{6}$-scale model. A heat treated specimen had lower acoustic emission in comparison with a hydrogen baked out specimen tested at the same temperature. (JRD)

15218 (ORO-3908-4) STUDY OF THE STRUCTURE AND MECHANICAL PROPERTIES OF ORDERED ALLOYS. Progress Report, January 1, 1972–December 15, 1972. LeFevre, B. G.; Starke, E. A. Jr. (Georgia Inst. of Tech., Atlanta. School of Chemical Engineering). 1972. Contract AT(40-1)-3908. 151p. Dep. NTIS.

Studies were made on the ordering transformation and some related mechanical properties in Ni_4Mo and CuPt. The short-range ordered structure present in as-quenched Ni_4Mo and the initial development of the long-range ordered structure has been studied using single crystal x-ray diffuse scattering techniques. An atomic model has been developed for the as-quenched structure which consists of clusters of Mo atoms on {100} planes and has a rodlike morphology. Stress-ordering studies have also been made on Ni_4Mo and clearly show that ordering under an applied stress can influence the kinetics of ordering, the microstructure and the mechanical properties. A significant increase in ductility was obtained in the sample ordered under an applied stress when compared with a stress-free ordered sample. Ordered 50 atomic percent copper–platinum has been deformed and examined by transmission electron microscopy. Both slip and {111} deformation twinning were observed. A model is offered to explain how the twinning is compatible with the $L1_1$ superlattice. (auth)

15219 SPECTRAL EMISSIVITIES OF LANTHANUM, CERIUM, AND PRASEODYMIUM. Moscowitz, C. M.; Stretz, L. A.; Bautista, R. G. (Ames Lab., IA). High Temp. Sci.; 4: No. 5, 372-8(Oct 1972).

The spectral emissivities of liquid lanthanum, cerium, and praseodymium were determined by comparison of the surface brightness temperature to the true temperature. The sample was placed in a tantalum crucible containing a black-body cavity and heated under vacuum with an induction furnace. An automatic optical pyrometer was used to measure the brightness temperature of the sample surface and the blackbody cavity. The spectral emissivities were then calculated from this data. Oxidation of the sample surface prevented calculation of values for the solid phase. No variation of spectral emissivity with increasing temperature was detected. The spectral emissivities of the liquid metals at wavelength 0.645 μm are: for lanthanum, 0.282 ± 0.012, for cerium, 0.309 ± 0.020, and for praseodymium, 0.294 ± 0.020. The reported error is the standard deviation from the arithmetic mean. (auth)

15220 STRUCTURE AND PROPERTIES OF ALLOYS OT4 AND OT4-1 AFTER VACUUM ANNEALING. Kolachev, B. A.; Gorshkov, Yu. V.; Shevchenko, V. V.; Artsybasov, Yu. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 378-81(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 6-10(May 1972).

Results of the investigation show that vacuum annealing reduces hydrogen embrittlement of alloy OT4-1. The resistance to repeated static loading of samples with stress concentrators is improved by vacuum annealing of alloy OT4-1. To reduce the hydrogen content in finished parts the use of vacuum annealing at 670°C for 2 h and subsequent oxidation of the surface of plates by admitting air into the system at 300 to 400°C is recommended. On the surface of plates after vacuum annealing of alloys OT4 and OT4-1 at 1000 to 1100°C there are steps, the majority of them five-sided. This is due to the imperfect shape of the polycrystals constituting the metal. (auth)

15221 VACUUM ANNEALING OF TITANIUM ALLOYS. Borisova, E. A.; Shashenkova, I. I.; Glebova, R. D. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 382-5(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 10-13(May 1972).

The effects of various annealing conditions on Ti-base VT6S and VT20 alloys were studied. It was found that vacuum annealing damages the surface layer. The first signs of surface etching are visible in metallographic analysis of VT6S after annealing at 650° for 2 h and for alloy VT 20 at 750 to 800°C. (JRD)

15222 MECHANICAL PROPERTIES OF TITANIUM ALLOYS WITH ISOMORPHOUS β-STABILIZING ELEMENTS. Khorev, A. I. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 386-90(1972).

Translated from Metalloved. Term. Obrab. Metal.; No. 5, 13-18(May 1972).

The effects of additions of Mo and V on the mechanical properties of Ti-3% Al alloys were studied. It was found that Ti–Al–Mo alloys have a higher strength in the annealed and thermally hardened conditions than Ti–Al–V alloys. To reduce the amount of molybdenum, which is hard to dissolve, it is expedient to add two β-stabilizing elements together—molybdenum and vanadium. The sensitivity of these alloys to overheating in the β region increases with alloying up to the critical concentration. In the annealed condition they are less sensitive than in the thermally hardened condition. The investigation showed the validity of analyzing changed in the mechanical properties in relation to the amount of β-stabilizing elements nominally equivalent to molybdenum. (JRD)

15223 MARTENSITIC TRANSFORMATION DURING DEFORMATION OF TITANIUM ALLOYS WITH METASTABLE β PHASE. Moiseev, V. N. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 391-5(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 18-23(May 1972).

The mechanical properties and phase composition of titanium-base alloys were studied. It was established by x-ray analysis that metastable β and α'' phases can transform during plastic deformation. The large difference between the ultimate and yield strengths observed in titanium alloys quenched to metastable β phase decreases greatly with increasing degrees of cold plastic deformation. This limits the use of the high plasticity of quenched α + β titanium alloys. The region was determined in which β phase is mechanically unstable in binary titanium alloys of Mo, V, Nb, Ta, Fe, and Cr (alloys containing up to 20% Mo, 20% V, 50% Nb, 50% Ta, 4% Fe, or 12% Cr). The addition of aluminum substantially increases the tendency of metastable β phase to transform during deformation. The addition of eutectoid-forming elements (Fe, Cr, Mn) to alloys containing elements isomorphous with β titanium (Mo and V) with composition close to the critical composition inhibits the martensitic transformation during deformation. Lowering the temperature from room temperature to −196° negligibly reduces the tendency of metastable β phase to transform during deformation. (auth)

15224 SUSCEPTIBILITY TO BRITTLE FRACTURE OF SIMULATED WELD SEAMS IN Ti–Al–V ALLOYS. Mikhailov, V. I. Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 399-401(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 27-30(May 1972).

The effects of heating cycles associated with welding of Ti–Al–V alloys were studied. It was found that lowering the testing temperature and raising the deformation rate do not induce embrittlement of Ti + 3.5% Al + 20% V or the weld zone. Stress concentrators do not have a decisive effect. However, because of the local deformation they lead to greater reduction of the general deformability and the amount of energy the material can absorb. Under certain structural conditions α + β alloys (Ti + 3.5% Al + 4–10% V) are more sensitive to lowering of the testing temperature and raising the deformation rate than α alloys, especially with higher concentrations of vanadium. Stress concentrators have almost the same effect on this group of alloys as on single-phase α alloys. (JRD)

15225 HEAT RESISTANT Ni–Cr–Nb SPRING ALLOYS. Barseg'yan, L. V.; Platova, S. N.; Belov, B. G.; (and others). (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 406-9 (1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 35-9(May 1972).

Development of nonmagnetic heat-resistant Ni-base spring alloys containing Cr, Nb, Mo, and W is reported. Additional alloying of alloy 70NKhBMYu with tungsten and increasing the chromium content produced new nonmagnetic spring alloys 70NKhBMVYu and 60NKhBMVYu with a high heat resistance and corrosion resistance in media based on concentrated nitric acid. Alloys 70NKhBMVYu and 60NKhBMVYu have a high plasticity (δ = 30–42%) after quenching to γ solid solution, which makes it possible to manufacture tape and wire from them and also elastic sensing elements of complex shape. After tempering for 750°C for 5 h the alloys have a high strength, and particularly the elastic limit ($\sigma_{0.005}$ = 110 to 128 kg mm^2), as well as satisfactory relaxation resistance up to 550 to 600°C. The alloys are hardened during tempering due to the decomposition of the supersaturated solid solution with precipitation of finely dispersed phase of the Ni_3Nb type with a fcc lattice. Results of tests of the new alloys as materials for elastic sensing elements of the membrane type indicate that the alloys can be used at operating temperatures up to 550°C. (JRD)

15226 COPPER IN HEAT RESISTANT ALLOYS. Nazarov, E. G.; Yakovleva, E. F.; Bogomolova, G. P. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 429-30(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 53-4(May 1972).

The effects of Cu additions on the structure and properties of Ni-base KhN70VMTyu alloys containing Cr, Ti, Mo, W, and Al were studied. It was found that adding up to 3% Cu to alloy KhN70VMTYu does not affect the mechanical properties or long-term strength. In amount up to 3%, copper somewhat improves the scale resistance at 1000°C, but has no substantial effect on the corrosion resistance in boiling 20% sulfuric acid. Copper enters into the composition of the strengthening γ' phase of the $(Ni, Cu)_3(Al, Ti)$ type, replacing part of the nickel and increasing the lattice constant of the γ' phase. (auth)

15227 EFFECT OF HYDROSTATIC EXTRUSION ON THE COMPOSITION AND PROPERTIES OF Nb_3Sn COMPOUNDS. Vereshchagin, L. F.; Konyaev, Yu. S.; Berzon, E. M.; Veller, M. V. (Inst. of Physics of High Pressure, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 447-9(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 65-6(Mau 1972).

Results of deformation of Nb_3Sn by hydraulic extrusion was studied. Results show that Nb_3Sn has a variable composition with a fairly wide range of homogeneity. Differences in hardness were found and attributed to the deviation of the composition from the stoichiometric composition. (JRD)

15228 EFFECT OF ALLOYING ON THERMAL EXPANSION OF SUPERINVAR ALLOY. Zakharov, A. I.; Perepelkina, A. M.; Shiryaeva, A. N. (Central Scientific-Research Inst. of Ferrous Metallurgy, Moscow). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 539-41(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 6, 62-4(Jun 1972).

The effects of small additions of Si, Mn, Cu, Mo, Nb, Re, Cr, and Ti on the thermal expansion of Superinvar alloy (31 to 33% Ni, 4 to 6% Co and remainder Fe) was examined at 20 to 80°C. It was found that with up to 0.6% Cu, up to 0.6% Mo, up to 0.6% Nb, up to 0.2% Cr, up to 0.9% Mn, and up to 0.6% Re the stability of the γ phase increases, raising the expansion coefficient. Small amounts of silicon substantially increase the expansion coefficient and lower the stability of γ phase. With an increase of the silicon from 0.06 to 0.1% the expansion coefficient rises from -2×10^{-7} deg^{-1} to 21×10^{-7} deg^{-1} at 20 to 80°C and M_S rises from −40 to 0°C. The silicon content of Superinvar must be held to a minimum. (JRD)

15229 OXYGEN SOLUBILITY IN THE Va-METALS VANADIUM, NIOBIUM, AND TANTALUM. Jehn, H.; Fromm, E. (Max-Planck-Institut fuer Metallforschung, Stuttgart). Metall; 26: No. 10, 1007-11(Oct 1972). (In German).

The oxygen solubility in the metals with high melting point of the Va group: vanadium, niobium, and tantalum is examined. The newer results of electromotive force measurements with ThO_2 and Y_2O_3 electrolytes are presented. Data are included on saturation concentrations, equilibrium activities, and state diagrams of these metals. (tr-auth)

15230 INFLUENCE OF TEMPERATURE ON THE BOND BETWEEN NICKEL ELECTRODEPOSITS AND URANIUM. Dini, J. W.; Johnson, H. R.; Helms, J. R. (Sandia Labs., Livermore, CA). J. Nucl. Mater.; 45: No. 4, 343-346(Jan 1973).

Ring shear tests of nickel-plated uranium showed that samples heated for 1 h at temperatures as high as 316°C suffered no reduction in bond strength. Heating at 371°C and above for one hour caused a gradual reduction in bond strength but no severe degradation. Long-term heating (up to 42 h) at 550°C reduced bond strengths noticeably due to the formation of brittle nickel–uranium intermetallics. However, even these samples exhibited some residual bond strength, e.g., 18,800 psi (13.2 kg/mm^2) after 18 h and 12,300 psi (8.7 kg/mm^2) after 42 h, compared to the 36,800 psi (25.9 kg/mm^2) bond strength of the unheated specimen. (auth)

15231 ABSOLUTE THERMOLECTROMOTIVE FORCE OF LIQUID BINARY ALLOYS. Mikhailovskii, B. I.; Khar'kov, E. I. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 2, 222-9 (Feb 1972). (In Russian).

Concentrational dependences of absolute thermoelectromotive forces were studied for liquid binary alloys Pb–Bi, Sn–Ga, In–Zn, Zn–Ga and Bi–Zn. The results obtained are discussed within the terms of the J. Ziman electronic theory of liquid metals and alloys. (auth)

15232 SYMMETRY OF THE STRUCTURE OF THE ω PHASE IN Zr AND Ti ALLOYS. Sass, S. L.; Borie, B. (Cornell Univ., Ithaca, NY). J. Appl. Crystallogr.; 5: No. 3, 236-238 (1972).

The symmetry of the structure of the as-quenched ω phase, which is formed during the decomposition of bcc (β) solid solutions in Zr- and Ti-base alloys, was shown to change from sixfold to threefold with increasing solute content. These observations indicate that as the undercooling beneath the M_s curve for the $\beta \rightarrow \omega$ transformation decreases, the magnitude of the displacement of the atoms from their bcc positions during the transformation also decreases. (auth)

15233 INTERACTION OF INTERMETALLIC COMPOUNDS RuTi–RuHf. Gulamova, D. D.; Raevskaya, M. V.; Sokolova, I. G.; Litvak, F. S.; Sokolovskaya, E. M. Vestn. Mosk. Univ., Ser. II. Khim.; 13: No. 4, 489-90(1972). (In Russian).

The permanent intersolubility of compounds RuTi and RuHf was established by physico-chemical analysis. (auth)

15234 ESTIMATES OF THE DRIVING AND RETARDING FORCES DURING SPREADING OF LIQUIDS OVER THE SURFACES OF SOLIDS WHICH THEY WET. Kostikov, V. I.; Mitin, B. S.; Summ, B. D. (Moscow Inst. of Steel and Alloys). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 7, 1045-8(Jul 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 7, 1190-3(Jul 1972).

The existing theories of the driving forces of spreading for cases of complete wetting ($\theta = 0$) of solid surfaces are discussed. It is shown that investigations of the kinetics of spreading can yield information on the mechanism and character of the spread of a liquid over the surface of a solid. Experimental results are included on the kinetics of spreading of various liquid metals and oxides over the surface of solids. (auth)

15235 EQUILIBRIUM IN THE SYSTEM In–Br_2. Voronin, V. A.; Sandulova, A. V.; Zaidovskii, E. G.; Kulikov, L. M. (Lvov Polytechnical Inst.). Inorg. Mater. (USSR) (Engl. Transl.); 8: No. 7, 1150-1(Jul 1972).

Translated from Izv. Akad. Nauk SSSR, Neorg. Mater.; 8: No. 7, 1306-7(Jul 1972).

The chemical equilibrium in the system In–Br_2 was investigated to obtain thermodynamic data on this system and to determine conditions under which a liquid phase appears in the system. Data on the temperature dependence of the total pressure in the In–Br_2 system at 750 to 1050°K are included. (JRD)

15236 FRICTION AND WEAR OF RARE EARTH METALS IN AIR. Rabinowicz, E.; March, P. A. (Massachusetts Inst. of Tech., Cambridge). J. Less-Common Metals; 30: 145-51(1973).

Friction and wear rates have been measured for combinations of the rare earth metals cerium, lanthanum, dysprosium, holmium, and yttrium, the alloys misch metal and didamium, and the metals zinc, aluminum, copper, iron, titanium, and zirconium, sliding in air, unlubricated. It was found that the rare earth metals show rather lower friction coefficients and rather higher wear rates than do other metals, because they oxidize so readily. The cubic structured metals show higher friction than do the hexagonal structured metals; of the hexagonal metals, especially low friction is associated with a high c/a ratio of the crystal lattice. It was concluded that, owing to their high oxidation rates, the rare earth metals sliding in air do not show the great degree of promise that they display in a vacuum environment. (auth)

15237 NOTE ON THE CRYSTAL STRUCTURE OF $ThCu_{3.6}$. Bailey, D. M. (Ames Lab., Iowa). J. Less-Common Metals; 30: 164-6(1973).

The successful indexing of a Debye–Scherrer powder pattern of $ThCu_{3.6}$, taken with Co radiation, based on the $GdAg_{3.6}$ structure is reported. Visual comparison of the $ThCu_{3.6}$ pattern with the pattern of $GdAg_{3.6}$ showed that, except for the scale difference due to the difference in lattice parameters, the patterns were virtually identical. Thus indexes could, in most cases, be assigned to the $ThCu_{3.6}$ pattern by direct comparison with the $GdAg_{3.6}$ pattern. Lattice parameters $a = 11.812 \pm 0.008$ and $c = 8.844 \pm 0.009$ Å for the hexagonal lattice were determined by a least-squares fit to the Nelson–Riley extrapolation by computer. (PCH)

15238 CHEMICAL TRANSPORT OF TANTALUM: A DEMONSTRATION EXPERIMENT. Schaefer, Harald (Univ., Muenster, Ger.). J. Less-Common Metals; 30: 141-3(1973). (In German).

The chemical transport of tantalum by means of iodine is suitable for demonstrations. Details of the experiment, which may be demonstrated in a few minutes, are given. (auth)

15239 PHASE DIAGRAMS OF PALLADIUM WITH YTTRIUM, SAMARIUM, GADOLINIUM, DYSPROSIUM, HOLMIUM, AND ERBIUM. Loebich, O. Jr.; Raub, E. (Forschungsinstitut fuer Edelmetalle und Metallchemie, Schwaebisch-Gmuend, Ger.). J. Less-Common Metals; 30: 47-62(1973). (In German).

Phase diagrams of Pd–Ln alloys (Ln = Y, Sm, Gd, Dy, Ho, and Er) were investigated by differential thermal analysis and metallographic and powder x-ray diffraction techniques. In general 7 phases were found to exist: $LnPd_3$, Ln_4Pd_5, and LnPd melting congruently, $LnPd_2$, Ln_2Pd_3, and Ln_3Pd_2 formed by peritectic reactions, and Ln_5Pd_2 melting congruently for Ln = Y, Dy, and Er and incongruently for Ln = Sm, Gd, and Ho. Sm_2Pd_3 could not be detected and Gd_2Pd_3 occurs only between 1130° and 1160°C. The peritectically formed $SmPd_5$ compound was unique. Structural data are given for the $LnPd_3$, LnPd, On_3Pd_2, and Ln_2Pd_2, intermetallic compounds. (auth)

15240 EFFECT OF OXYGEN IN STATIC SODIUM ON VANADIUM AND VANADIUM ALLOYS. II. ALLOYS CONTAINING TITANIUM AND ZIRCONIUM. Klueh, R. L.; Devan, J. H. (Oak Ridge National Lab., TN). J. Less-Common Metals; 30: 25-37 (1973).

Static capsules were used to compare the effects of oxygen in sodium on vanadium alloys with that on unalloyed vanadium. Specimens of the alloys and unalloyed vanadium were simultaneously exposed to sodium containing 2000 ppM O. Alloys tested were: V–20% Ti, V–15% Cr–5% Ti, V–1.3% Zr, V–5% Zr, Vanstar 7, Vanstar 8, and Vanstar 9. All the alloys tested contained either titanium or zirconium and formed internal oxide precipitates when they gettered oxygen from the sodium. Observations on the internally oxidized alloys are discussed in terms of existing internal oxidation theory. (auth)

15241 EFFECT OF OXYGEN IN STATIC SODIUM ON VANADIUM AND VANADIUM ALLOYS. I. UNALLOYED VANADIUM, VANADIUM–CHROMIUM, AND VANADIUM–MOLYBDENUM ALLOYS. Klueh, R. L.; Devan, J. H. (Oak Ridge National Lab., TN). J. Less-Common Metals; 30: 9-24(1973).

Static capsule tests were used to investigate the effects of oxygen in sodium on vanadium and vanadium alloys. When unalloyed vanadium in a vanadium capsule was exposed at 600 and 800°C to sodium that contained up to 1500 ppM O, the specimen and capsule gettered all the oxygen. Vanadium specimens were also exposed to sodium containing up to 4000 ppM O at 600°C in capsules of type 304L stainless steel and molybdenum. Except when the sodium contained over 2000 ppM O, all oxygen was gettered. It was concluded that the oxygen distribution coefficient between vanadium and sodium, that is, the ratio of the oxygen concentration in the vanadium to that in the sodium, at equilibrium, is greater than 10^4. To compare the effect of oxygen in sodium on various vanadium alloys with that on unalloyed vanadium, specimens of the alloys and unalloyed vanadium were simultaneously exposed to sodium containing 2000 ppM O. The results on vanadium alloys can be divided into two groups: alloying elements that form more stable oxides than vanadium and therefore form internal oxides and those that form less stable oxides and do not oxidize internally. Alloys that do not oxidize internally are reported on; the alloys tested were: V–5% Cr, V–10% Cr, V–15% Cr, and V–20% Mo. Both chromium and molybdenum lowered the solubility of oxygen in vanadium, results that were explained in terms of the effect of chromium and molybdenum on the activity coefficient of oxygen in vanadium. (auth)

15242 MECHANICAL PROPERTIES OF POLYCRYSTALLINE GADOLINIUM FROM 78 TO 675°K. Owen, C. V.; Scott, T. E. (Ames Lab., Iowa). J. Less-Common Metals; 30: 113-20(1973).

The flow stress temperature dependence, strain-rate sensitivity, strain-hardening exponent, and ductility of gadolinium were determined from 78 to 675°K at strain rates of 0.005, 0.01, 0.10, and 1.0 min^{-1}. The results are presented and similarities of some of the results to those obtained for other rare-earth metals are discussed. (auth)

15243 FORMATION AND STRUCTURE OF PRECIPITATES IN A DILUTE MAGNESIUM–NEODYMIUM ALLOY. Pike, T. J.; Noble, B. (Univ. of Nottingham, University Park, Eng.). J. Less-Common Metals; 30: 63-74(1973).

The precipitation behavior of a binary Mg–0.5 at.% Nd alloy has been studied by electric resistivity and electron microscope techniques. A general scheme of precipitation is proposed, and the conditions defined under which each phase precipitates. G.P. zones were found to exist, their formation being dependent on the quenched-in vacancy population as in aluminum alloys; in addi-

tion, there were two further nonequilibrium phases, and the equilibrium precipitate. The morphology and structure of each of these phases has been investigated, and related to the good elevated temperature strength shown by this alloy. (auth)

15244 HoPtSn AND OTHER INTERMETALLIC COMPOUNDS WITH THE Fe_2P-TYPE STRUCTURE. Dwight, A. E.; Harper, W. C.; Kimball, C. W. (Northern Illinois Univ., DeKalb). J. Less-Common Metals; 30: 1-8(1973).

Crystallographic and Moessbauer studies have been made on new ternary equiatomic compounds R.E.XSn (X = Rh, Pd, Ir, Pt) which have a hexagonal crystal structure, isostructural with Fe_2P ($D_{3h}^3 - P\bar{6}2m$). A typical example is HoPtSn with $a_0 = 7.418 \pm 0.001$ Å, c/a = 0.535, and V/M = 63.00 Å. The x-ray analysis leads to the following site assignments: Ho located in 3(g) sites at x, 0, ½; Pt atoms in 1(b) at 0, 0, ½, and 2(c) at ⅓, ⅔, 0; and Sn atoms in 3(f) at x, 0, 0. The volume per formula weight of YbRhSn is intermediate between those of TmRhSn and LuRhSn which indicates that Yb is trivalent in these compounds. The ^{119}Sn Moessbauer spectra at 295°K are symmetrical or slightly asymmetrical doublets which have been fitted to the model of site occupation given by the crystallographic results for HoPtSn. An asymmetry in the spectrum at 295°K vanishes at 77.3°K for TbRhSn; this behavior is indicative of an anisotropic Debye–Waller factor. The isomer shift at 295°K is similar for all alloys; a typical value is +1.8 mm/s (compared to +2.6 mm/s for β-Sn). However, the quadrupolar coupling varies by a factor of two (0.34 to 0.70 mm/s). At 4.2°K TbRhSn and HoPtSn shows asymmetric broadening which is interpreted as magnetic in origin. At 77.3°K GdRhSn is broadened by 40% which may indicate magnetic order above this temperature. (auth)

15245 METALLOGRAPHY OF ZIRCONIUM HYDRIDE PRECIPITATION IN A MAGNESIUM-0.5 WT. PERCENT ZIRCONIUM ALLOY. Nuttall, K. (Univ. of Newcastle-upon-Tyne, Eng.); Gradwell, K. J. J. Nucl. Mater.; 45: No. 3, 201-10(Dec 1972).

Transmission electron microscopy has been used to study the precipitation sequence during internal hydriding of a homogenized Mg/0.5 wt % Zr alloy. At low hydriding temperatures (435°C), a fine homogeneous dispersion of coherent, plate-like precipitates containing zirconium and hydrogen was formed on {0001} planes of the Mg matrix. The precipitate was stable for prolonged periods at 435°C in a hydrogen atmosphere, but dissolved fairly readily at 500°C in argon. At high hydriding temperatures (530 or 600°C) the first observed precipitate was as porous discs on {0001} Mg, each of which consisted of a number of smaller particles. With continued hydriding, the intermediate precipitate discs developed facets and coalesced to eventually form solid hexagonal-shaped plates of the equilibrium ZrH_2, which had an orientation relationship with the Mg matrix given by: $(111)_{ZrH_2}$ // $(0001)_{Mg}$, and $[20\bar{2}]_{ZrH_2}$ //$[1120]_{Mg}$. (auth)

15246 ELASTIC MODULI OF ALPHA, BETA, AND GAMMA POLYCRYSTALLINE URANIUM. Armstrong, P. E.; Eash, D. T.; Hockett, J. E. (Los Alamos Scientific Lab., NM). J. Nucl. Mater.; 45: No. 3, 211-16(Dec 1972).

A series of measurements of Young's modulus and shear modulus was made on well-characterized, isotropic, polycrystalline uranium using thin-rod resonance techniques. Data were obtained over the temperature range from 20 to 1120°K. The results agreed with single crystal uranium moduli, reported by Fisher and McSkimin, when these have been averaged by suitable techniques. Young's and shear modulus values for α-uranium were 29.1 and 11.8×10^6 psi, respectively, at 300°K; those for β-uranium were 13.3 and 4.5×10^6 psi at 1000°K; and Young's modulus for γ-uranium was 3.3×10^6 psi at 1010°K. It appears that texture may be developed by repeated thermal cycling from room temperature to high in the alpha-phase region (860°K). It also appears that heating the textured specimen into the beta-phase or gamma-phase regions removes the texture, restoring the original isotropy. (auth)

15247 EFFECT OF QUENCHING ON THE SLOW-BEND BEHAVIOUR OF HYDRIDED ZIRCONIUM. Hardie, D. (Univ. of Newcastle-upon-Tyne, Eng.). J. Nucl. Mater.; 45: No. 3, 265-8(Dec 1972).

Slow-bend testing of hydrided Zr specimens in the quenched condition revealed a transition in the fracture energy-temperature curve, as in the furnace-cooled specimens but at a considerably lower temperature. Therefore, a furnace-cooled specimen gave a low-energy failure at ambient temperature whereas a quenched specimen gave a high-energy failure. Thus quenching does not produce behavior similar to that in the vacuum-annealed condition and this is consistent with the nonretention of H in solution. It was concluded that hydride precipitate can introduce an embrittling effect in Zr whatever its crystallographic structure and the degree of embrittlement depends primarily upon the fineness of distribution. (PCH)

15248 β → ω TRANSFORMATIONS IN THE METALLIC ALLOYS IN THE TERNARY SYSTEM Ti–Zr–O. Dechamps, Michel (CNRS, Vitry-sur-Seine, France); Lehr, Pierre; Dubertret, Alain; Fayard, Michel. Mater. Res. Bull.; 7: No. 12, 1369-84(Dec 1972). (In French).

X-ray studies of the metallic alloys in the ternary system Ti–Zr–O show the existence of phases α, β, $\omega_{(o)}$ and of a new phase $\omega'_{(o)}$. This phase $\omega'_{(o)}$ appears in the alloy Ti_2ZrO after a long anneal at low temperature. Its structure is described in the space group Cmmm (a = 4.8387 Å; b = 8.1486 Å; c = 6.1042 Å; 8 Ti atoms in 8 n with y = 0.338 and z = 0.254; 4 Zr atoms in 2 a + 2 d; 4 0 atoms in 4 e). The filiation of the phases shows the existence of ordering phenomena in the distribution of Ti and Zr atoms during the transformation $\beta \rightarrow \omega_{(o)}$, and in the distribution of 0 atoms during the transformation $\omega_{(o)} \rightarrow \omega'_{(o)}$. (auth)

15249 VALENCE RELATIONSHIPS IN THE R. F. SPARK MASS SPECTRUM FROM SOLIDS. Muheim, J. T. (Laboratorium fuer Festkoerperphysik, Zurich). Mater. Res. Bull.; 7: No. 12, 1417-21(Dec 1972).

In the phenomenon of the rf spark between identical solids in the vacuum, the solid itself is found to be involved in a complex way. The discovery of valence relationships derived from the molecular part of the positive mass spectrum from low-valent solids is reported. (auth)

15250 MECHANICAL PROPERTIES OF INTERSTITIAL ALLOYS OF NIOBIUM. Ulitchny, M. G.; Gibala, R. (Case Western Reserve Univ., Cleveland). J. Less-Common Metals; 30: 177-80(1973).

Studies were made in an effort to identify the mechanism responsible for alloy softening in various interstitial Nb alloys. The study indicated that softening results from effects of interactions between interstitial solutes of different hardening potentials such that the number, effectiveness or distribution of solute barriers to dislocation motion are changed, and that such softening is a general phenomenon that is not dependent upon the particular interstitial solutes present. (PCH)

15251 THERMODYNAMIC STUDIES OF LIQUID Zn-In-Pb SOLUTIONS. DETERMINATION OF MISCIBILITY GAP, ISOACTIVITY OF ZINC AND MOLAR THERMODYNAMIC FUNCTIONS. Moser, Z.; Fitzner, K. (Inst. of Metal Research, Krakow). Met. Trans.; 3: No. 12, 3109-14(Dec 1972).

Electromotive force measurements were conducted with liquid electrodes and electrolyte to determine the thermodynamic properties of liquid Zn–In–Pb solutions for wider ranges of zinc concentration and composition ratios, X_{Pb}/X_{In}, than heretofore. The experiments were performed for 9 pseudo-binary alloys of constant ratio X_{Pb}/X_{In} and at temperatures 714, 757, 805, 842, and 877°K. The experimental results were used for the calculation of zinc activity, for isoactivity plots, and also for the determination of the range of immiscibility in the liquid state. The experimental results of zinc activity were compared with analogous data obtained from Krupkowski's formulae. Secondly, the molar excess free energy and molar enthalpy of liquid Zn–In–Pb solutions were calculated by means of the Krupkowski and Darken methods. (auth)

15252 SYMPOSIUM ON REFRACTORY METALS. PART II, Spring Meeting of the Metallurgical Society of AIME, Atlanta, Georgia, May 17–21, 1971. Met. Trans.; 3: No. 12, 3068-3107 (Dec 1972). (CONF-710557-(Pt.2)).

Seven articles are included; a separate abstract was prepared for each. (PCH)

For abstracts of individual papers see: 15253–15259.

15253 MECHANISMS AND KINETICS OF ABSORPTION AND DESORPTION REACTIONS IN SYSTEMS OF REFRACTORY METALS WITH NITROGEN, OXYGEN, OR CARBON. Hoerz, Gerhard (Max-Planck-Institut fuer Metallforschung, Stuttgart). Met. Trans.; 3: No. 12, 3069-76(Dec 1972).

From Spring meeting of the Metallurgical Society; Atlanta, GA (17 May 1971). See CONF-710557-(Pt.2).

The mechanisms and kinetics of the reactions of absorption of oxygen and nitrogen in group VA refractory metals and to the reactions of desorption of oxygen and nitrogen from group VA and VIA refractory metals are discussed. The kinetic data are compiled and discussed in connection with problems of practical interest. On the basis of new results, the carburization of niobium in flowing methane or acetylene is presented and the decarburization of niobium using the reaction between flowing oxygen and dissolved carbon to give carbon monoxide is treated. (auth)

15254 PRECIPITATION OF CARBON FROM SOLID SOLUTION IN VANADIUM. Mosher, D. R. (Univ. of Colorado, Boul-

der); Diercks, D. R.; Wert, C. A. Met. Trans.; 3: No. 12, 3077-80(Dec 1972).

From Spring meeting of the Metallurgical Society; Atlanta, GA (17 May 1971). See CONF-710557-(Pt.2).

Precipitation of carbon from supersaturated solid solution in vanadium has been measured using internal friction, electrical resistance, and transmission electron microscopy. The precipitation rate was found to fit an equation $w = 1 - \exp[-(t/\tau)^n]$. Values of n near 0.5 imply a one-dimensional diffusional process. An Arrhenius plot of τ is consistent with diffusion of carbon, thus the precipitation rate must largely be dependent on rate of carbon diffusion. Precipitates formed in the range of aging temperatures 100 to 200°C are very finely divided; they can barely be observed by transmission electron microscopy even with prolonged aging. (auth)

15255 DISLOCATION DYNAMICS IN NIOBIUM-OXYGEN SOLID SOLUTIONS. Ravi, K. V.; Gibala, R. (Case Western Reserve Univ., Cleveland). Met. Trans.; 3: No. 12, 3081-5(Dec 1972).

From Spring meeting of the Metallurgical Society; Atlanta, GA (17 May 1971). See CONF-710557-(Pt.2).

The dislocation velocity-stress exponent m* has been calculated from measurements of the strain rate sensitivity of the effective stress τ^* for single crystals of niobium–oxygen solid solutions which exhibit alloy softening. The values of m* evaluated at small plastic strains were found to be a sensitive function of temperature and oxygen concentration. Analysis of these results in terms of Peierls-Nabarro and dislocation-interstitial solute hardening mechanisms infers the latter is rate controlling. Furthermore, alloy softening is best interpreted in terms of the effects which solute interaction processes have on the thermally activated hardening caused by oxygen. (auth)

15256 DISLOCATION DAMPING IN HIGH PURITY MOLYBDENUM. Olsen, D. R.; Carpenter, S. H. (Univ. of Denver). Met. Trans.; 3: No. 12, 3087-92(Dec 1972).

From Spring meeting of the Metallurgical Society; Atlanta, GA (17 May 1971). See CONF-710557-(Pt.2).

Dislocation interstitial interactions in high-purity molybdenum have been investigated by means of internal friction measurements. A Marx piezoelectric composite oscillator with a resonant frequency of 50 kHz was used to measure the log decrement as a function of time, temperature, and strain amplitude. Measurements on slightly cold worked samples showed that at temperatures above 100°C the amplitude-independent damping decreased with time. This effect has been explained in terms of the diffusion of interstitial nitrogen to the dislocation lines pinning them and rendering them immobile. An activation energy for the process has been found to be between 1.12 and 1.18 eV which agrees with the diffusional energy of interstitial nitrogen in molybdenum. In the two purer grades of molybdenum, a maximum was observed in the amplitude-dependent damping. The damping maximum was observed after annealed samples were deformed at room temperature. The behavior of the damping maximum has been studied as a function of temperature and various thermomechanical treatments. The damping maximum is attributed to the motion of dislocations produced by deformation, which have a very low concentration of breakable pinning points along the dislocation lines. (auth)

15257 MECHANICAL BEHAVIOR OF CHEMICAL VAPOR DEPOSITED TUNGSTEN. Chun, J. S.; Shim, H. S.; Byrne, J. G. (Univ. of Utah, Salt Lake City). Met. Trans.; 3: No. 12, 3093-6 (Dec 1972).

From Spring meeting of the Metallurgical Society; Atlanta, GA (17 May 1971). See CONF-710557-(Pt.2).

Hoop stress and tensile tests have been completed between 800 and 1600°C on chemical vapor deposited (C.V.D.) tungsten specimens. Scanning electron microscopy of slip surfaces showed a fairly constant value of slip band spacing of between 2 and 20 μ. Fracture face morphologies suggest a transition from brittle failure at 800°C to ductile fibrous failure at 1400°C. Slip band intersections were almost exclusively at 90 deg indicating {110} slip planes with ⟨100⟩ zone axes. The latter fact confirmed earlier ⟨100⟩ fiber axis results from x-ray diffraction. Ductility first increased from 800 to 1400°C, above which it decreased. (auth)

15258 CREEP OF FINE WIRES OF W–ThO_2 ALLOYS. Moon, D. M. (Westinghouse Electric Corp., Pittsburgh). Met. Trans.; 3: No. 12, 3097-3102(Dec 1972).

From Spring meeting of the Metallurgical Society; Atlanta, GA (17 May 1971). See CONF-710557-(Pt.2).

The increasing interest in the application of fine wires as high-strength structural components, e.g., in high temperature composite materials, makes an understanding of the differences between the creep behavior of large specimens and that of fine wires desirable. The creep properties of fine wires of recrystallized W–1 wt pct ThO_2 were studied over the temperature range between 1800 to 2750°C. In tungsten wires in which the dispersion of fine thoria particles stabilized a fine grained structure, the stress dependence of the creep rate varied with test temperature and stress. For test temperatures below 2500°C, a stress dependence of $n \sim 5$ was found, indicative of creep deformation due to dislocation climb processes, while for temperatures above 2500°C and low stresses, values of $n < 2$ were obtained, indicative of deformation by grain boundary sliding and diffusional creep processes. In wires which recrystallized to a large-grained structure, having a large aspect ratio, a high stress dependence of 15 was found when tested at 1800°C. (auth)

15259 EFFECT OF A TEMPERATURE GRADIENT ON BUBBLE GROWTH IN TUNGSTEN. Dawson, C. W. (Westinghouse Incandescent Lamp Div., Bloomfield, NJ). Met. Trans.; 3: No. 12, 3103-7(Dec 1972).

From Spring meeting of the Metallurgical Society; Atlanta, GA (17 May 1971). See CONF-710557-(Pt.2).

Bubble distributions in doped tungsten wires have been examined following high temperature anneals (2500 to 3000°C) both in the presence and absence of a thermal gradient. Electron and optical microscopy showed that much more bubble growth occurs during gradient anneals, and the results suggest that the gradient is a driving force for bubble growth. This process took place predominantly on the grain boundaries. Semiquantitative estimates of the bubble flux were made by measuring the change in aggregate bubble surface areas found at various positions in the gradient. Stress induced bubble growth was found not to be a factor. (auth)

15260 MICROSTRUCTURES AND TRANSFORMATION KINETICS OF CONTINUOUSLY COOLED CARBON FREE FE–Mo–Ni ALLOYS. Cryderman, R. L. (Climax Molybdenum Co. of Michigan, Ann Arbor). Met. Trans.; 3: No. 12, 3149-59(Dec 1972).

Continuous-cooling transformation diagrams were determined for twenty high purity alloys of iron containing up to 4 pct Mo and up to 4 pct Ni. The transformation diagrams of all of the molybdenum-containing alloys were composed of two distinct temperature regions for the transformation of austenite to ferrite, a high temperature transformation region at low cooling rates and a low temperature transformation region at high cooling rates. The respective 50 pct transformation points, T_H for the high temperature transformation and T_L for the low temperature transformation, were selected to describe the transformation characteristics of the alloys. As the molybdenum content was increased, T_L was lowered. Incremental additions of molybdenum raised T_H at low nickel contents and lowered T_H for nickel contents in excess of 3 pct. Increases in nickel content lowered both T_H and T_L by equal amounts, regardless of molybdenum content. Examination of the microstructures of the continuously cooled specimens by transmission electron microscopy revealed that ferrite formed at T_H had relatively low dislocation density. Transformation at T_L produced many small subgrains of high dislocation density. (auth)

15261 DEFORMATION MECHANISM FOR HIGH-PURITY VANADIUM AT LOW TEMPERATURES. Wang, C. T.; Bainbridge, D. W. (Oregon State Univ., Corvallis). Met. Trans.; 3: No. 12, 3161-5(Dec 1972).

Two grades of polycrystalline vanadium and one grade of single crystal vanadium were strained in tension using temperature change and strain rate change techniques to study the controlling deformation mechanism at temperatures between 77 and 293°K. An abrupt change of yield stress, flow stress, and strain rate sensitivity indicated that a change of rate-controlling mechanism took place at approximately 200°K. At temperatures below 200°K, the Peierls mechanism is probably dominating. At temperatures between 200 and 293 K, the predominant controlling process was probably the interaction between dislocations and interstitial impurities. Mechanical twins were developed in single crystals deformed at 77 and 120 K; the twinning plane was {211}. Slip lines could not, in general, be identified, but were noted in one contaminated specimen. Single crystals generally showed a chisel edge type of ductile fracture. (auth)

15262 ALIGNED Ni–In EUTECTICS. Livingston, J. D. (General Electric Research Development Center, Schenectady, NY). Met. Trans.; 3: No. 12, 3173-6(Dec 1972).

Directional solidification of two eutectic alloys in the Ni–In system resulted in aligned microstructures. The eutectic at 26.5 at. pct In solidified as ribbons and lamellae of nickel-base solid solution in a matrix of ϵ-Ni_3In. Peritectoid formation of Ni_3In on cooling drastically altered the morphology, but this reaction can be suppressed by quenching. The peritectoid reaction can then be studied by isothermal heat treatments. The eutectic at 46.6 at.

pct In solidified partly as rods of ϵ-Ni_2In in a matrix of β-NiIn, partly in a lamellar morphology. Both phases transformed on cooling, but because little composition change was involved, the effects on eutectic morphology were slight. (auth)

15263 CHROMIUM DIFFUSION IN Ni–20 Wt PCT Cr–3 VOL PCT Y_2O_3 AND Co–21 WT PCT Cr–3 VOL PCT Y_2O_3. Seltzer, M. S. (Columbus Labs., OH). Met. Trans.; 3: No. 12, 3259-62 (Dec 1972).

In order to further investigate the effects of fine grain substructure on chromium diffusion in dispersoid-containing alloys, measurements were made of ^{51}Cr diffusivities in Ni–20 wt % Cr–3 vol % Y_2O_3 and Co–21 wt % Cr–3 vol % Y_2O_3 prepared by mechanical alloying. The results showed that diffusivities for the Ni-base alloy were similar to those obtained previously by Fleetwood (J. Inst. Metals, Vol 94, p. 218 (1966)) for Ni–5 ThO_2, and were more than an order of magnitude higher than the rates found for Cr diffusion in coarse grained Ni–20 Cr and TD-NiCr. The data indicate the importance of dislocation substructure, rather than the dispersoid per se in producing alloys with enhanced constituent diffusivities. Low diffusion activation energies for Cr in the Ni–5 ThO_2 and Ni–20 Cr–3 Y_2O_3 alloys as compared with the Ni–20 Cr and TD–NiCr are further evidence to support the hypothesis that chromium diffuses in the former alloys by a short-circuit mechanism; the most likely one being diffusion along dislocations. The results also suggest that Cr diffusion in the Co-base alloy also occurs by a short-circuit mechanism. It was also concluded that enhanced Cr diffusivity is not responsible for the rapid formation of Cr_2O_3 scales on dispersoid-containing Ni- and Co-base alloys. (PCH)

15264 DISCUSSION OF THE EFFECT OF ENVIRONMENT AND GRAIN SIZE ON THE CREEP BEHAVIOR OF A Ni–6PCT W SOLID SOLUTION. Johnson, W. R.; Barrett, C. R.; Nix, W. D.; Achter, M. R. Met. Trans.; 3: No. 12, 3262(Dec 1972).

The authors (Johnson, Barrett, and Nix, Met. Trans., Vol 3, pp. 695 to 698(1972)) previously reported that the rupture life of a Ni–6% W alloy is shorter in commercial purity argon than in vacuum. The possibility of grain boundary contamination by an impurity in the gas is cited as an explanation for the observation. Previously published data that support this mechanism and which can be used to identify the probable impurity in the gas are cited. Ample evidence that only a small amount of reactive gas is required to increase rates of crack propagation substantially was found by Shahinian and Achter (Proc. of Joint Int. Conf. on Creep, Sect. 7, pp 49 to 57, Inst. of Mech. Eng. (1963)) in work with nitrogen. A nitrogen pressure of approximately 2×10^{-6} atm (about 10^{-3} torr) was used by the authors. It is believed that this pressure is sufficient to put their data on the plateau where the environmental effect is a maximum. It is concluded that nitride formation at grain boundaries is the most probable mechanism to account for the environmental effect. (PCH)

15265 STUDY OF PRECIPITATION AT ELEVATED TEMPERATURES IN A Mg–8.7 PCT Y ALLOY. Mizer, D.; Peters, B. C. (Dow Chemical Co., Midland, MI). Met. Trans.; 3: No. 12, 3262-4 (Dec 1972).

Precipitation in Mg–8.7% Y alloy was studied at temperatures above 200°C. The results suggest that the Mg-base–Y alloy has at least three stages of precipitation: the hardening precipitation, i.e., 200°C and below; the precipitate occurring between 200 to 300°C; and the equilibrium precipitate that occurs above 300°C. Neither the intermediate nor the equilibrium precipitate hardened the material. Also the lower temperature precipitate did not act as a nucleus for the higher temperature precipitate. The nucleation of the hardening precipitate appeared to be quite homogeneous. However the nucleation of the intermediate and equilibrium precipitate appeared to be quite difficult and more heterogeneous, i.e., on dislocations and grain boundaries. (PCH)

15266 METASTABLE PHASES IN BINARY NICKEL ALLOYS CRYSTALLIZED AT HIGH COOLING RATES. Varich, N. I.; Petrunina, A. N. (Dnepropetrovsk State Univ., USSR). Fiz. Metal. Metalloved.; 33: No. 2, 335-8(Feb 1972). (In Russian).

The following alloys were crystallized at high cooling rates (10^7 to 10^8 degrees/sec) and then subjected to x-ray and metallographic methods of investigation: Ni–Mo, Ni–Ta, Ni–Nb, Ni–Ti, and Ni–Zr. In alloys which had been crystallized from liquid at 2,000°C, a maximum supersaturation of the α-solid solution was achieved. If these same alloys had been crystallized from 1,900°C liquid, interstitial metastable phases were detected side by side with the metastable α-solid solution. (tr-auth)

15267 SELF-DIFFUSION IN TUNGSTEN AND TUNGSTEN–RHENIUM ALLOYS. Korolev, A. A.; Pavlinov, L. V.; Gavrilyuk, M. I. Fiz. Metal. Metalloved.; 33: No. 2, 295-302(Feb 1972). (In Russian).

The diffusion of W in W alloys containing 6, 11, and 22 weight % Re was measured. The diffusion coefficients were determined by the method of integral remainder using the isotope ^{185}W at temperatures 1,935 to 2,500°C. The self-diffusion coefficient in pure W can be described by the formula $D = 8.2 \times 10^{-2} \exp[-(120700 \pm 8200/RT)]$ cm²/sec. The alloying of W by Re up to 22% essentially raises the diffusion coefficient and lowers the activation energy and the frequency factor. (tr-auth)

15268 PHASE DIAGRAM OF THE SYSTEM LANTHANUM–GERMANIUM. Eremenko, V. N.; Zyong-Kuok-Shi; Buyanov, Yu. I.; Kharkova, A. M. (Kiev State Univ.). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 9, 819-23(1972). (In Ukrainian).

A complete phase diagram for the lanthanum–germanium system was plotted for the first time as a result of microstructural, differential thermal, dilatometric, and x-ray phase analyses. The compound La_3Ge, unknown before, and which crystallizes in the tetragonal system was discovered. The formation mechanisms of metallic compounds within the system were established: La_3Ge is formed according to the peritectic reaction $L + La_5Ge_3 \rightleftharpoons La_3Ge$; La_4Ge_3 and La_5Ge_4 according to peritectoid ones $La_5Ge_3 + 3LaGe \rightleftharpoons 2La_4Ge_3$ and $La_4Ge_3 + LaGe \rightleftharpoons La_5Ge_4$, respectively. La_5Ge_3 and $LaGe_{2-x}$ are melted congruently, and LaGe is crystallized from the melt in the presence of La_5Ge_3. It was found that phases on the basis of lanthanum and compounds La_3Ge, La_5Ge_3, La_4Ge_3 and La_5Ge_4 did not solve the components. The absence of polymorphism in the phases La_5Ge_3 and LaGe was found. Temperature of polymorphic transformation $LaGe_{2-x}$ changed from 420 to 455°C in the homogeneity region. X-ray analyses showed that the high-temperature phase $LaGe_{2-x}$ belongs to the structural type α-$ThSi_2$ and the low-temperature one to α-$GdSi_2$ type. (auth)

15269 KINETICS OF TRANSFORMATION OF THE γ PHASE OF URANIUM–ZIRCONIUM–NIOBIUM AND URANIUM–NIOBIUM–MOLYBDENUM ALLOYS. Gomozov, L. I.; Makhova, V. A.; Gomov, V. V.; Ivanov, O. S. (Inst. of Metallurgy, Moscow). Fiz. Metal. Metalloved.; 33: No. 2, 307-14(Feb 1972). (In Russian).

Isothermal conversion of the γ-phase of solid solution at 500 to 630°C were investigated in the alloys U–Zr–Nb and U–Nb–Mo containing 85% U. Investigative methods included dilatometric, microstructure, and x-ray techniques. For the ternary alloys U–Zr–Nb, when the composition of the resulting γ-phase was relatively close to the original, decomposition proceeded homogeneously and in accordance with a single kinetic mechanism. Use of Abrami's formula gave n = 1 to 2.2. The remaining alloys decomposed homogeneously in two stages, where the second stage (diffusion control) corresponded to the value n = 0.5 to 0.8. The alloy with the atomic % ratio Zr : Nb = 3 : 1 decomposed to a stable structure, apparently due to an equality of parameters of the initial and the generated γ phase. (tr-auth)

15270 FORMATION OF METASTABLE ORDERED ω-PHASE ON AGING OF MARTENSITE IRON–NICKEL–COBALT–MOLYBDENUM ALLOYS. Edneral, A. F.; Perkas, M. D. (Inst. of Metal. Metalloved.; 33: No. 2, 315-25(Feb 1972). (In Russian).

An electron microscopy study was made of the structure of martensite alloys H18M6, H16K15M5, and H12K15M10 after aging at 440°C for 16 hours. Upon adding Co to a martensite-aged Fe–Ni–Mo (5 to 10% Mo) there was formed a homogeneous enriched Mo concentrated inhomogeneity, highly dispersed with an ordered arrangement of Mo atoms. The size of the separated phase was ~30 Å, and it was characterized by a distorted bcc lattice, close to the lattice of the hexagonal ω-phase. The probable change in composition of the separated material was $A_5B \rightarrow A_7B_2 \rightarrow A_2B$, where A = Fe, Ni, and Co, and B = Mo. The composition indicated was metastable, and with an aging temperature of 520°C, the separation of the ordered ω-phase progressed into a more equilibrated intermetallic phase $(Fe, Ni, Co)_2Mo$. (tr-auth)

15271 ORDERING KINETICS IN NICKEL–MOLYBDENUM ALLOYS. Artsishevskaya, L. F.; Malysheva, I. B.; Selisskii, Ya. P. (Inst. of Precision Alloys, Moscow). Fiz. Metal. Metalloved.; 33: No. 2, 377-82(Feb 1972). (In Russian).

The structural peculiarities of the ordering process in the alloys Ni–15 at. % Mo and Ni–20.2 at. % Mo were studied by electron microscope and x-ray methods. Ordering proceeded slowly in these alloys. In all thermal treatments selected (annealing at 600, 700, and 800°C) the ordered phase Ni_4Mo was formed with a tetragonal lattice. Change of lattice type during ordering evoked the formation of a complex domain structure which consisted of perpendicular twinning and anti-phase domains, the dimensions and form of which depended on the annealing temperature. (tr-auth)

15272 ORDERING OF SOLID SOLUTIONS OF ALUMINUM IN VANADIUM. Sidorenko, F. A.; Doroshenko, A. V.; Gel'd, P. V. (Ural Polytechnic Inst., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 33: No. 2, 426-7(Feb 1972). (In Russian).

An alloy was prepared from 99.95% V and 99.999% Al so as to approximate the composition AlV. It was a single-phase, bcc lattice, a = 3.074 Å, density = 4.51 g/cc. Neutron reflection by this alloy was studied with a monochromatic beam of neutrons. A considerable difference in ordering results existed between the x-ray and the neutron studies, and was attributed to a difference in state of the samples studied. (KSW)

15273 MECHANISM OF THE INITIAL STAGE OF ORDERING IN NICKEL–MOLYBDENUM ALLOYS. Kirienko, V. I.; Potapov, L. P. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 33: No. 2, 436–40(Feb 1972). (In Russian).

Structural changes in Ni alloys containing ~18 at. % Mo were studied with an autoionic microscope at 78°K. At 700°C the structure, analogous to early stages of ordering, was observed up to one hour of annealing. Regions of the phase Ni_4Mo were manifest on a background of unordered fcc lattice. (KSW)

15274 MARTENSITIC PRETRANSFORMATION PHENOMENA IN THE Au–47.5 at. PERCENT Cd AND THE Fe–29.7 at. PERCENT Ni ALLOYS. Livingston, H.; Mukherjee, K. (Polytechnic Inst. of Brooklyn). J. Appl. Phys.; 43: No. 12, 4944–50(Dec 1972).

Premartensitic transformation characteristics were investigated in the Au–47.5 at.% Cd and the Fe–29.7 at.% Ni alloys by measuring electrical resistivity and magnetoresistance. Preliminary electron diffraction studies were also made for the Au–Cd alloy. An anomalous magnetoresistance peak was observed for both of these alloys prior to the martensitic transformation. In the Au–Cd alloy, this peak was about 2 to 3°C above the M_s, and for the Fe–Ni alloy it was about 5 to 6°C above the M_s. Furthermore, when the M_s was lowered by isothermal stabilization, this peak moved in conjunction with the new M_s temperature. This indicates that the observed peak is truly associated with the premartensitic instability of the parent phase. The electron-diffraction pattern of the parent phase of the Au–Cd alloy shows extensive ⟨110⟩ and ⟨112⟩ streaking in the temperature range where anomalous magnetoresistance was observed. These experimental results could tentatively be interpreted in terms of anisotropic scattering centers resulting from localized strain inhomogeneities. Presumably these inhomogeneities are associated with the atomic shuffling prior to the actual phase transformation and could be identified with the so-called "strain embryos." (auth)

15275 EFFECT OF NITROGEN ON THE ELECTRICAL AND STRUCTURAL PROPERTIES OF TRIODE-SPUTTERED TANTALUM FILMS. Wilmott, D. J. (Bell-Northern Research, Ottawa). J. Appl. Phys.; 43: No. 12, 4865–71(Dec 1972).

The structural and electrical properties of nitrogen-doped tantalum films, sputtered in a dc triode system, were investigated. For constant sputtering voltage and current, the tantalum deposition rate decreased with increasing nitrogen flow rate; at a flow rate of 12 $cm^3\ min^{-1}$, the deposition rate was 75% of the rate obtained without the addition of nitrogen. The density of the films decreased from 15.4 to 9.8 $g\ cm^{-3}$ as the nitrogen flow increased from 0 to 12 $cm^3\ min^{-1}$. The net effect on the film thickness is an increase from 2700 to 3800 Å for films on glass substrates. Films were also deposited on ceramic substrates at the same time. Both x-ray diffractometer and powder camera analysis showed that the films consisted of the bcc Ta phase at nitrogen flows up to 3 $cm^3\ min^{-1}$ but the lattice was approximately 3% larger than for bulk Ta. The hcp Ta_2N phase appeared at flow rates above 3 $cm^3\ min^{-1}$ and the change from bcc Ta to hcp Ta_2N was accompanied by an increase in the room-temperature coefficient of resistance from positive to negative values. For films on glass, the resistivity was approximately 250 μΩ cm as the nitrogen flow increased from 4 to 8 $cm^3\ min^{-1}$ but the resistivity had a monotonic increase for films on ceramic substrates. The hcp Ta_2N phase was replaced by the fcc TaN phase as the flow rate increased in this range; the latter phase had a preferred (111) orientation on the substrate. As the flow rate increased from 8 to 12 $cm^3\ min^{-1}$, the resistivity increased rapidly for both types of substrates and the temperature coefficients became rapidly more negative. It is suggested that this behavior is due to the presence of an insulating nitride phase in the film. (auth)

15276 ZIRCONIUM IN NUCLEAR TECHNOLOGY. Greenfield, P. London; Mills and Boon (1972). 62p.

The preparation of zirconium and its principal alloys, corrosion and hydriding, and hydride morphology are discussed. A chapter on physical properties, under the following headings: effects of hydrogen on tensile properties, effects of neutron irradiation on tensile properties, creep properties, impact resistance and fracture toughness is included. Nuclear applications are described, with special reference to fuel element cans and to pressure tubes in water-cooled reactors. Additional data are presented on the effects of hydrogen and neutron irradiation on mechanical properties, and problems of creep and fatigue are further discussed. (UK)

15277 WEAKLY ALLOYED CARBON STEEL FOR REACTOR PRESSURE VESSELS. Rossi, F. (Centro Sperimentale Metallurgico, Rome). pp 15–52 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The criteria for the selection of the type of steel for the construction of a pressure vessel are examined. The principal types of steel used experimentally are tabulated. The increase of the reactor power and therefore of the thickness of the vessel walls has cast doubts on the validity of the criterion which bases the design of thick-walled pressure vessels on the knowledge of the mechanical characteristics of the material neglecting the effect of possible heterogeneities due to the thickness of the components or to eventual possible defects in fabrication. This criterion is re-examined in the the light of this argument. The possibility of containing within certain limits or even of negating the effects of irradiation on the steel is considered. (JSR)

15278 STRENGTH OF NICKEL REINFORCED BY TUNGSTEN FIBERS. Golovin, V. N.; Rybal'chenko, N. D.; Somov, A. I.; Tron, A. S. (Physical-Technical Inst., Kharkov). Probl. Prochnosti; 3: 91–94(Nov 1971). (In Russian).

The mechanical properties in tension of nickel sheet containing 4 to 16% tungsten fiber were examined. The deformation characteristics of the fibers during vacuum rolling together with the plastic matrix were studied. The fracture characteristics of the composite at temperatures between 20 and 800°C were determined. (IAA)

15279 GROWTH AND MORPHOLOGY OF InBi WHISKER CRYSTALS. Huckle, J. R. (Univ. of Alabama, Huntsville); Davis, J. H.; Lal, R. B.; Nicolas, D. P. J. Cryst. Growth; 16: No. 1, 43–4(Oct 1972).

The growth of whiskers of compound InBi by the "squeeze technique" is reported. Rotating crystal x-ray analysis and melting point measurements confirmed that the whiskers were InBi. The whisker axis coincided with the ⟨101⟩ direction for all three whiskers. Scanning electron microscope photographs indicate that the whiskers share the irregular cross section and ribbonlike morphology of other "squeeze-grown" metal whiskers. (auth)

15280 USE OF A VANADIUM ALLOY OF HIGH CREEP STRENGTH AS NUCLEAR REACTOR MATERIAL. Wincierz, P.; Ruehle, M.; Reddemann, B. H.; Boehm, H. O.; Schirra, M. (to Gesellschaft fuer Kernforschung mbH). German Patent 1,758,397. 20 Jul 1972. (In German).

A vanadium base alloy with titanium, zirconium, and/or hafnium content ranging from 0.1 to ≤ 2.8% and minor additions of carbon, nitrogen, and oxygen of less than 0.3% was developed. The material has a surprisingly high creep strength, a high corrosion resistance against liquid alkali metals as well as a good plasticity, and therefore is very suitable to be used as material for structural components and fuel element cans in nuclear reactors. (GF)

15281 TANTALUM: PHYSICO-CHEMICAL PROPERTIES OF ITS COMPOUNDS AND ALLOYS. Kubaschewski, O. (ed.). At. Energy Rev., Special Issue; No. 3,1–133(Dec 1972).

A critical evaluation and documentation of data on Ta, including thermodynamic properties, densities, crystallographic structures, equilibrium diagrams and diffusion rates in the condensed states are given. A total of 895 references is included. (PCH)

15282 EFFECT OF RARE EARTH METALS UPON THE MECHANICAL PROPERTIES OF CHROMIUM. Gorbach, V. G.; Rakitskii, A. N.; Rudoi, A. P.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Probl. Prochnosti; 4: 78–82(Feb 1972). (In Russian).

When such elements as Sc, Y, La, Ce, Pr, Nd, Gd, and Er were added to electrolytic, hydrogen-refined chromium (in concentrations of 0 to 2% by weight), the low-temperature ductility characteristics of the resultant alloys were essentially altered. On this basis, the optimal content of the rare earth metals in the alloys should be 0.2 to 0.7%. The effects of the rare earth metals upon the mechanical properties of chromium at higher temperatures (around 1000 C) were not significant. (IAA)

15283 PHASE EQUILIBRIA IN THE Co–Cr–W SYSTEM WITH SPECIAL EMPHASIS ON THE R-PHASE. Barrows, R. G. (Lewis Research Center, Cleveland); Newkirk, J. B. Metallography; 5: No. 6, 515–41(Dec 1972).

The equilibrium phases at 1350°C were studied in twenty-one ternary of binary alloys in the Co–Cr–W system. Three topologically close-packed phases were found, one of which is a new

phase which is isomorphous with the prototype R-phase in the Co–Cr–Mo system. The crystallographic verification of the Co–Cr–W R-phase is given, including comparisons of observed and calculated d-spacings and line intensities. Also, certain metallographic characteristics of the R, μ, σ, and α–Co phases are described, with special emphasis on the response of these phases to potentiostatic electrolytic etching. A ternary phase diagram for the Co-rich region at 1350°C is proposed which is consistent with the data obtained and with most other published work relating to this system. (auth)

15284 FRACTURE SURFACE CHARACTERISTICS RELATED TO DIFFUSION BOND QUALITY IN 6 Al–4 V–Ti. Wolanski, Z. R.; Ashton, J. H. (General Dynamics, Fort Worth, TX). Metallography; 5: No. 6, 543-56(Dec 1972).

Fracture surface characteristics were determined using both optical and electron fractographic methods to examine incompletely bonded specimens and base-metal strength (static) diffusion-bonded specimens. Examination of the incompletely bonded specimens revealed numerous areas having fracture surface characteristics unique to diffusion-bonded specimens in which overload was the major reason for ultimate failure. When the fracture surfaces of bonded specimens exhibiting entirely standard titanium static properties were examined, minute areas were found having these same unique fracture surface characteristics. The presence of these areas of inhomogeneity had not in any way changed the static properties, but their existence may be of considerable importance in dynamic (fatigue) and fracture arrest properties of a diffusion-bonded structure. (auth)

15285 SCANNING ELECTRON MICROSCOPY STUDY OF DEFORMATION AND FRACTURE IN A Ni–18.1 a/o V ALLOY. Moreen, H. A.; Taggart, R.; Polonis, D. H. (Univ. of Washington, Seattle). Metallography; 5: No. 6, 561-5(Dec 1972).

The use of scanning electron microscopy in an investigation of the deformation and fracture characteristics of a Ni-base–V binary alloy containing the ordered Ni_3V phase is discussed. The scanning electron micrograph of the fracture surface of a solution treated and quenched alloy was typical of a ductile type fracture. The fractograph indicated that the fracture mechanism changed from ductile to brittle mode as the result of aging treatment. The aging process produced precipitation of the ordered Ni_3V phase in the binary NiV alloy and increased both the yield strength and the strain hardening rate of the alloy. The elongation of the as-quenched Ni–V specimen at fracture was greater than 60%, whereas it was only 7% in the aged condition. Evidence of coplanar slip was also observed in the scanning electron micrographs of the deformed surfaces of the tensile specimens. In the aged specimens the slip was confined to a single slip system on widely spaced planes, whereas in the quenched specimen multiple-slip plane traces were found. The observations of coplanar slip and brittle fracture in the aged alloy were interpreted as evidence that a precipitate cutting mechanism occurs. (PCH)

15286 RECRYSTALLIZATION OF W–1 WT. PERCENT ThO_2 WIRE. Dunham, T. E.; Daga, R. L. (General Electric Co., Cleveland). Met. Trans.; 4: No. 1, 175-84(Jan 1973).

The recrystallization behavior of W–1 wt pct ThO_2 wires of two sizes, 0.457 and 0.178 mm (18 and 7 mil), was studied using optical microscopy, transmission electron microscopy, hardness, and resistivity ratio techniques. For the 0.178 mm wire the effects of heating rate were also analyzed. Recrystallization of the 18 mil wire was characterized by rather gradual changes in hardness, resistivity ratio, and microstructure leading to a small recrystallized grain size. The 0.178 mm wire, on the other hand, exhibited more abrupt changes in resistivity ratio and hardness which coincided with the development of a recrystallized structure having a large grain-size range. Variation of heating rates between about 150,000°C/min and 500°C/min did not significantly affect the grain structure or hardness achieved for annealing temperatures of 2000, 2500, and 2700°C. However, very slow heating rates, less than 10°C/min, were found to prevent the formation of large grains in the 0.178 mm wire. These results are explained on the basis of differences in the effectiveness of ThO_2 particles in hindering grain boundary motion. (auth)

15287 DEFORMATION MODES OF HCP YTTRIUM AT 77, 298, AND 497 K. Carnahan, T. G.; Scott, T. E. (Iowa State Univ., Ames). Met. Trans.; 4: No. 1, 27-32(Jan 1973).

Single crystals of hcp yttrium were tested in several orientations, including plane strain and bending, at 77, 298, and 497°K to establish the deformation modes. The primary slip system was $\{10\bar{1}0\}\langle 1\bar{2}10\rangle$ but $(0002)\langle 1\bar{2}10\rangle$ slip occurred in plane strain compression when prism slip was prevented by constraints. Twinning occurred primarily in the $\{11\bar{2}1\}\langle \bar{1}\bar{1}26\rangle$ system while the common hcp twin system, $\{10\bar{1}2\}\langle \bar{1}011\rangle$, with the smallest shear was the secondary twinning mode. Twinning shears determined with the aid of interference microscopy agreed well with theoretical prediction. (auth)

15288 STABILITY OF THE DIRECTIONALLY SOLIDIFIED EUTECTICS NiAl–Cr AND NiAl–Mo. Walter, J. L.; Cline, H. E. (General Electric Corp. Research and Development, Schenectady, NY). Met. Trans.; 4: No. 1, 33-8(Jan 1973).

The eutectics NiAl–Cr with cylindrical chromium fibers and NiAl–Mo with faceted molybdenum fibers were heated at 1400°C to determine the stability of the composite structure and to compare the stability of the nonfaceted fibers with that of the faceted fibers in the NiAl matrix. Fiber size and size distribution and number of fibers per unit area were measured as a function of time at temperature. The number of fibers in the NiAl–Cr eutectic decreased continuously reaching half the initial value in about 30 h at temperature. Spheroidization of the fibers occurred and was complete in 160 h. In the NiAl–Mo eutectic, the number of fibers per unit area remained constant to 150 h and the fiber size was constant to 331 h at 1400°C. In NiAl–Cr, the cylindrical chromium fibers first formed pinched-off segments at random diameter variations along the length of the fibers. The segments gradually shortened and thickened and finally spheroidized. The faceted molybdenum fibers remained stable because the Mo–NiAl interface was constrained to lie in the facet plane which inhibited the formation of faults leading to pinching off of the fibers. (auth)

15289 MORPHOLOGY OF Y' AND Y'' PRECIPITATES AND THERMAL STABILI: OF INCONEL 718 TYPE ALLOYS. Cozar, R.; Pineau, A. (L'Ecole des Mines de Paris, Corbeil, France). Met. Trans.; 4: No. 1, 47-59(Jan 1973).

The precipitation of the γ' ($L1_2$) and γ'' (DO_{22}) phases has been studied in four alloys of Fe–Ni–Cr–Ti–Al–Nb containing a higher Ti + Al/Nb ratio than that of the INCONEL 718 alloy. For these alloys, the precipitation microstructure varied rapidly with aging temperature and composition. Bct γ'' particles have always been found to precipitate on γ' phase. Moreover, by aging three alloys above a critical temperature, a "compact morphology" has been observed: cube-shaped γ' particles coated on their six faces with a shell of γ'' precipitate. This microstructure has proved to be very stable on prolonged aging. A thermal stability better than that encountered in nominal INCONEL 718 alloy can thus be achieved. The influence of composition and aging temperature on the conditions that bring about this "compact morphology" has been investigated. A minimal Ti + Al/Nb ratio between 0.9 and 1 has been determined, allowing the "compact morphology" to be obtained. (auth)

15290 SELF-DIFFUSION IN LIQUID TIN AND INDIUM OVER EXTENSIVE TEMPERATURE RANGES. Foster, J. P. (Westinghouse Advanced Reactors Div., Madison, PA); Reynik, R. J. Met. Trans.; 4: No. 1, 207-16(Jan 1973).

The capillary-reservoir technique has been used to study the diffusion of ^{113}Sn and ^{125}Sb in liquid tin from 665 to 1746°K, and the self-diffusion of ^{114}In from 621° to 1378°K. Multichannel scintillation radiotracer analyses were used to determine the total amount of diffusate migrating either into or out of a capillary tube. A definite wall effect was observed for ^{114}In at 775°K. On the basis of the broad temperature range diffusivity data obtained, experimental criteria were established for very accurate measurement and calculation of liquid metal diffusivities using the capillary-reservoir technique. These criteria include: selection of the capillary tube material and diameter, determination of the magnitude of the Δl effect, and careful identification of the radioisotopes employed in the determination of the diffusivities. It was found that the diffusion data do not fit any of the available theoretical models over the complete temperature range, nor any empirical relations of the form $D = AT^n$. The observed nonlinear variation of log D vs log T was correlated with the disappearance of a second structure in the liquid state of tin. (auth)

15291 DIFFUSION OF HYDROGEN IN TITANIUM ALLOYS DUE TO COMPOSITION, TEMPERATURE, AND STRESS GRADIENTS. Waisman, J. L. (McDonnell Douglas Astronautics Co., Huntington Beach, CA); Sines, G.; Robinson, L. B. Met. Trans.; 4: No. 1, 291-302(Jan 1973).

A theoretical and experimental study was conducted to determine the combined effects on interstitial diffusion in metals of gradients in interstitial concentration, in solvent composition, in stress, and in temperature. The theory consolidates relationships, some of which have been previously published. It is based on macroscopic irreversible thermodynamics, and is applicable to anisotropic or isotropic materials. Experiments were conducted and literature analyzed to determine the numerical quantities required to predict the change in hydrogen distribution with time for pure and alloy titanium, where the solvent gradient, stress gradient, and

temperature gradient are constant with time. The diffusion driving forces for solute gradient, solvent gradient, and stress gradient are related to the effect of each factor on hydrogen activity. In addition, the material property which determines the diffusion driving force of a stress gradient for anisotropic material is a matter tensor analogous to the scalar partial molal volume used for isotropic material. The experiments, conducted with commercially pure titanium and titanium alloy, 6Al–4V, consist of measuring the effect of alloy additions and stress on the hydrogen activity in solid solution and the dilatation effect of hydrogen. Stress states tested were tension, compression, and torsion. The measurements were made by exposing titanium and the alloy to hydrogen at temperatures from 600 to 800°C, and measuring the equilibrium hydrogen gas pressure at various solid solution hydrogen contents. Both materials were tested with and without stress. Tension decreased the activity, compression increased it, and torsion had no effect. This is consistent with the stress effect theory of Li, Oriani, and Darken. The stress effect corresponds to an apparent partial molal volume of 1.7 to 2.2 cm^3/mol, depending on the alloy and hydrogen content. (auth)

15292 STRENGTH AND TOUGHNESS OF Fe–10Ni ALLOYS CONTAINING C, Cr, Mo, AND Co. Speich, G. R.; Dabkowski, D. S.; Porter, L. F. (United States Steel Corp., Monroeville, PA). Met. Trans.; 4: No. 1, 303-15(Jan 1973).

The effects of C (0.10 to 0.20 pct), Cr (0 to 3 pct), Mo (0 to 2 pct), and Co (0 to 8 pct) on the yield strength, toughness (Charpy shelf energy), and tempering behavior of martensitic 10Ni–Cr–Mo–Co steels have been investigated. Variations in the carbon content between 0.10 and 0.20% resulted in yield strengths between 160 and 210 ksi (1.1 and 1.45 GN/m^2) when these steels were tempered at 900 to 1000°F (480 to 540°C) for times of 1 to 100 h. These steels exhibited a secondary-hardening peak at 900 to 1000°F (480 to 540°C) where coarse Fe_3C carbides were gradually replaced by a fine, dislocation-nucleated dispersion of $(Mo, Cr)_2C$ carbides. Maximum toughness at a given yield strength in these steels was only obtained when they were tempered for sufficiently long times so that the coarse Fe_3C carbides were completely dissolved. Molybdenum was primarily responsible for the secondary-hardening peak observed in these steels. However, chromium additions did result in lower secondary-hardening temperatures and promoted coarsening of the secondary-hardening carbide. Best combinations of strength and toughness were obtained with steels containing 2% Cr and 1% Mo. Cobalt increased the yield strength of these steels over the entire tempering range and resulted in a higher secondary-hardening peak. This effect of cobalt was attributed to a retardation in the rate of recovery of the dislocation substructure of the martensite, the formation of a finer dispersion of secondary-hardening carbides, and solid-solution strengthening. The finer dispersion of secondary-hardening carbides in steels containing cobalt was favored by the finer dislocation substructure in these steels since the $(Mo, Cr)_2C$ carbide was dislocation-nucleated. This fine dispersion of $(Mo, Cr)_2C$ carbide combined with the high nickel content accounted for the excellent combination of strength and toughness exhibited by these steels. (auth)

15293 FREQUENCY DEPENDENT LOW CYCLE FATIGUE CRACK PROPAGATION. Solomon, H. D. (General Electric Co., Schenectady, NY). Met. Trans.; 4: No. 1, 341-7(Jan 1973).

The frequency modified Coffin–Manson low cycle fatigue expression phenomenologically describes the influence of the cycling frequency on the fatigue life. This expression relates only to the fatigue life and as such does not enable the separation of the frequency influence on crack nucleation from that on propagation. The approach taken was to study directly the propagation phase of low cycle fatigue and to this end a frequency modified crack growth expression is presented. The experiments were performed on A286 (an iron-base superalloy) cycled at 1100°F with plastic strain limits. The influence of the cycling frequency is described in terms of two frequency regimes. At the lowest frequencies (below 0.05 cpm) varying the frequency did not change the time to failure. The crack growth rate is thus more a result of stress rupture than fatigue. At higher frequencies both time and cycles determine the crack propagation behavior. (auth)

15294 SOLUBILITIES OF CERIUM AND LANTHANUM NITRIDE IN IRON. Kor, G. J. W. (United States Steel Corp., Monroeville, PA). Met. Trans.; 4: No. 1, 377-9(Jan 1973).

The solubilities of Ce and La nitride in γ–Fe were determined in the temperature range 1273 to 1473°K from the nitrogen content of a series of binary alloys equilibrated with nitrogen gas at essentially 1 atm pressure. On an atomic basis, Ce and La were found to be about as good nitride formers in Fe as V. In a steel containing 30 to 40 ppM N about 0.4 to 0.5 wt % Ce or La would be needed to form a stable nitride at 1273°K. (PCH)

15295 NEW RELATIONSHIP BETWEEN PRE-STRAIN AND YIELD STRESS DROP DUE TO BAUSCHINGER EFFECT. Kishi, T.; Gokyu, I. (Tokyo Univ.). Met. Trans.; 4: No. 1, 390-2(Jan 1973).

A new relation between prestrain and yield stress decrease due to Bauschinger effect is presented. The Bauschinger effect was measured using a reversible torsion testing machine and thin wall hollow cylinder specimens with an ID of 10 mm, a wall thickness of 0.8 mm and a gage length of 50 mm. The mean strain rate was 1.6×10^{-4}/s. Specimens of Cu, α brass, Fe, steels, Ti, Zr, and Mg were tested. It was found that a decrease in yield stress due to Bauschinger effect can be defined by, $\tau_B = \tau_F - |\tau_R|$. Observed values of τ_B and γ_p for various irons and steels are given using a log–log plot. Good straight line fits of the data indicated that these results can be represented by a power relation $\tau_B = k\,\gamma_p^m$ where k and m are constants, and may be referred to as Bauschinger effect coefficient and Bauschinger effect exponent, respectively. In the absence of the Bauschinger effect, k vanishes. All the materials tested exhibited the same power relation between τ_B and γ_p. Therefore, the second equation can be considered as a general formula for the Bauschinger effect. (PCH)

15296 GRAIN REFINING MECHANISM IN ALUMINUM–TITANIUM–BORON ALLOYS. Baeckerud, L. Jernkontorets Ann.; 155: No. 8, 422-424(1971).

TiB_2 additions to an Al-melt are known to impart a very good grain refining effect. The fact that this effect is achieved only when adding the master alloy to the melt at least ½ h prior to casting, as well as careful thermal analysis, suggests that a series of chemical reactions takes place at incipient solidification. The reactions discussed are: $TiB_2 + Al \rightarrow (TiAl)B_2 + Ti$; $Ti + 3Al \rightarrow Al_3Ti$; and Al_3Ti + liquid → α-Al. (Metals Abstr.)

15297 STUDY OF COMPATIBILITY OF BORON FIBERS WITH TUNGSTEN SUBSTRATE AND TITANIUM MATRIX. Burykina, A. L.; Dzyadykevich, Yu.V.; Gorskii, V. V. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 48-53(Nov 1972). (In Russian).

Interaction of boron fibers with a tungsten core and with a titanium matrix was studied by the methods of metallography, x-ray phase and x-ray microspectral analyses, and microhardness measurement. It is established that at 1100°C interaction of boron fibers with a tungsten substrate is accompanied by formation of higher tungsten borides WB_4 and probably, WB_{12}. Boron fiber is stable in a titanium matrix to 900°C and at higher temperature titanium borides Ti_2B and TiB are formed as a result of unipolar diffusion of boron into titanium. (auth)

15298 SPECTROSCOPIC INVESTIGATION OF OXIDE INTERACTION WITH METAL SURFACE. COMMUNICATION III. SYSTEMS OF Al_2O_3–Me(Al, Cu, Ti, X18H9T STEEL, Ni, Co, Mo, W, Si). Karpinos, D. M.; Aivazov, V. Ya.; Listovnichaya, S. P. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 54-57(Nov 1972). (In Russian).

Infrared transmission spectra are described for thin films of aluminium oxide, applied to polished metal substrates. It is shown that boundary interaction between the metal and film results in appearance of stable polarization surface bonds which are preserved after annealing. The bonds may be determined rather accurately by the method of infrared spectroscopy. Besides, annealing results in the appearance of some bands that indicate the crystal structure of the film. (auth)

15299 DEPENDENCE OF WC–Co HARD ALLOY STRENGTH DURING EXTENSION AND BEND ON COBALT CONTENT. Ivenson, V. A. (All-Union Scientific-Research Inst. of Hard Alloys, Moscow). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 85-92 (Nov 1972). (In Russian).

A method is suggested for a mathematical analysis of the WC–Co hard alloy strength dependence on cobalt content conformably to a skeleton model of this alloy. It is shown that the idea of the viscous phase resistance to rapture on the carbide skeleton strength makes it possible to suggest a method for a quantitative description of this dependence. The curves of the obtained equation are compared with the experimental data. (auth)

15300 DEMONSTRATION OF ^{60}Co HEAT SOURCE CAPSULE PERFORMANCE. Angerman, C. L. (E. I. DuPont de Nemours and Co., Aiken, SC). Nucl. Technol.; 17: No. 3, 261-274 (Mar 1973).

Satisfactory performance of superalloy capsules at conditions typical of those expected in radioisotopic heat sources was demonstrated. Capsules of Hastelloy X, Hastelloy C, Inconel 600, and Haynes 25 were heated in air at 850 to 1000°C; those containing unirradiated cobalt metal were tested for up to 39,400 h (4.5 y), and those containing irradiated cobalt metal, for up to 19,500 h (2.2 y). These tests indicated that Hastelloy X is the best encapsulating material for these applications, and Hastelloy C is a good alternative. General agreement of the data on inactive and active capsules indicates that the performance of active

capsules is not significantly affected by the radiation field or the buildup of nickel from radioactive decay of the cobalt. (auth)

Radiation Effects

Refer also to abstracts 16414, 16425, 16426, 16556, and 16832.

15301 (CEA-CONF-2088) RADIATION EFFECTS IN AMORPHOUS ZIRCONIA. Leteurtre, J.; Soullard, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 9p. (CONF-720729-2). Dep. NTIS (U. S. Sales Only).

From 6th Yugoslav symposium and summer school on the physics of ionized gases; Split, Yugoslavia (16 Jul 1972).

Studies were made on the effects of thermal spikes induced by irradiation on crystallization in amorphous ZrO_2. The results showed that whenever crystallization occurred, experimental conditions were such that the equilibrium temperature of the ZrO_2 films was high enough to induce crystallization which thus did not result from individual thermal spikes. Whenever specimen equilibrium temperature was insufficient to induce crystallization, individual effects were observed if the particle energy loss was high enough. For displacement cascades able to produce transformed zones the primary threshold energy was found to be 60 keV. For track registration, the electronic excitation energy loss must be higher than 1000 eV/Å. Finally, from diffraction contrast experiments, transformed zones were thought to be, not crystalline, but only regions of improved atomic order. (auth)

15302 (COO—1367-50) EFFECT OF POINT DEFECTS ON MECHANICAL PROPERTIES OF METALS. Technical Progress Report, January 1—December 31, 1972. Meshii, M. (Northwestern Univ., Evanston, Ill. Dept. of Materials Science). 1972. Contract AT(11-1)-1367. 7p. Dep. NTIS.

Developments are reported for studies on etch pit study of motion and generation of dislocations in electron-irradiated Cu, effects of electron irradiation on mechanical properties of Fe, and theory of dislocation motion and strength in bcc metals. The dislocation etch pit method was also established Al single crystals and ZrH_2 purified Battelle-AISI Fe. A method for doping single crystal specimens with C in a controlled manner was also developed. (PCH)

15303 (IAE-2102) MECHANISM OF SWELLING OF IRRADIATED BORON STEEL. Al'tovskii, I. V.; Elesin, L. A.; Platonov, P. A.; Savel'ev, E. G. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 19p. (In Russian). INIS.

The swelling of irradiated boron steel at constant temperature and at a constant rate of temperature rise was investigated with a dilatometer. A quantitative model is proposed for the swelling process which involved a mechanism of capture of equilibrium vacancies which migrated through the material, the agent of capture being stationary bubbles. A differential equation was developed which described the establishment of the gas bubble equilibrium with respect to time. This equation enabled all the steps of the thermal treatment of the material to be described quantitatively, and the physical parameters of the process which occurred in the swelling of steel to be fixed. (tr-auth)

15304 (IAE-2109) METHODS OF TESTING ZIRCONIUM ALLOYS FOR DURABILITY AND STRESS RELAXATION IN MR REACTOR. Platonov, P. A.; Ivanov, A. N.; Orlov, M. S.; Bychkov, V. Z. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 12p. (In Russian). INIS.

Methods of testing Zr alloys for prolonged durability and stress relaxation during exposure in a reactor are described. During irradiation the temperature was maintained constant because of the change in the percentage composition or pressure of the gas mixture ($He + N_2$) in the thermal gap. Data are given on the prolonged durability (σ = 30 kg force/mm^2, 420 to 450°C), and on the stress relaxation (400°C) of a Zr alloy with 2.5% Nb during irradiation in the MR reactor. (tr-auth)

15305 ANOMALOUS CHANGES (ENLARGEMENT) IN TETRAGONALITY OF IRRADIATED MARTENSITE LATTICE DURING LOW-TEMPERATURE ANNEALING. Kritskaya, V. K.; Kurdyumov, G. V.; Narkhov, A. V. (Inst. of Metallurgical Research and Metal Physics, Moscow). Dokl. Akad. Nauk SSSR; 206: No. 3, 590-592(21 Sep 1972). (In Russian).

The authors had previously detected a reversible redistribution of carbon (disorder—order) in the irradiation of Fe—C solid solutions which led to anomalous changes in the crystal structure of martensite. The restoration of tetragonality in the irradiated martensite proceeded relatively slowly at room temperature. Samples of tempered steel were irradiated with 3 MeV electrons (dose = 10^{19} electrons/cm^2) and then heated to 60 and 125°C in order to ascertain whether restoration of an ordered distribution of C atoms would occur faster than at room temperature. The results indicated that the migration of C was accelerated by heating to relatively low temperatures: 60 to 70°C. (KSW)

15306 SUBTLE CHANGES IN THE STRENGTH OF IRRADIATED CRYSTALS. Troitskii, O. A.; Spitsyn, V. I.; Glazunov, P. Ya. (Inst. of Physical Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 206: No. 3, 597-600(21 Sep 1972). (In Russian).

Single crystals of very pure Zn, Pb, and Sn were exposed to a flux of ~2.5 MeV electrons (10^{13} electrons/cm^2 · sec) in liquid nitrogen, and then subjected to elongation and deformation tests. In all three metals, the radiation caused an increase in the limits of creep of the samples. A more complicated picture resulted when samples of the metals were irradiated during the elongation tests in the energy region higher than the threshold of knocking-on of atoms: creep limits were intermediate between values for unirradiated and preliminarily irradiated samples. (KSW)

15307 EFFECT OF IRRADIATION ON DIFFUSION-CONTROLLED CREEP PROCESSES. Duffin, W. J.; Nichols, F. A. (Westinghouse Electric Corp., West Mifflin, PA). J. Nucl. Mater.; 45: No. 4, 302-316(Jan 1973).

At temperatures below about half the melting point and under moderate stress, below the post-irradiated yield stress, a metal will, in a fairly high fast neutron flux ($\gtrsim 10^{13}$ n/cm^2 sec), suffer an enhanced creep compared to an unirradiated control held at the same temperature and state of stress. Ever since Schoeck's initial suggestion that the excess vacancies introduced by irradiation should cause an acceleration of the diffusion-controlled climb of edge dislocations over obstacles in their glide paths, there has been discussion on what conditions must exist (or indeed if there are any conditions) under which irradiation-accelerated diffusion will lead to an enhancement of the creep rate. It is shown, considering both vacancies and interstitials, that for irradiation-accelerated climb of edge dislocations to enhance creep two basic conditions are necessary. First, the climb must be followed by glide and only that deformation produced by the glide is increased by irradiation. Second, there must exist a net difference in the flux of irradiation-produced interstitials and vacancies into the dislocations. This difference must be provided by other sinks which preferentially absorb one type of defect. This difference cannot be simply caused by the interaction of dislocations of differing orientations with the applied stress field or a preferential attraction between one type of defect and the dislocations. Creep rates computed using a diffusion-controlled climb model are compared with creep rates of a zirconium-base alloy at 300°C, measured both during and following fast neutron bombardment. The model is shown to be reasonably consistent with such measurements. (auth)

15308 DIMENSIONAL CHANGES OF UNSTRESSED ZIRCALOY-2 AND Zr-2.5 WT. PERCENT Nb SPECIMENS IN A FAST NEUTRON FLUX. Ibrahim E. F.; Winegar, J. E. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Nucl. Mater.; 45: No. 4, 335-338(Jan 1973).

Dimensional changes of annealed Zircaloy-2, annealed Zr—2.5 wt % Nb and quenched and aged Zr—2.5 wt % Nb material from pressure tubes are close to those expected from calculations based on their crystal texture and changes in single crystals of zirconium. Irradiation temperature between 320 and 530°K has little effect on irradiation growth of Zircaloy-2 or Zr—2.5 wt % Nb. Dimensional changes on cold-worked Zircaloy-2 and Zr—2.5 wt. % Nb specimens cannot be predicted as well from texture as those for heat-treated specimens, possibly because of dimensional changes from stress-relieving and a component of growth due to cold-work. (auth)

15309 EFFECT OF IRRADIATION WITH ELECTRONS ON THE HARDENABILITY OF STEEL. Krishtal, M. A.; Ivanov, L. I; Ryazantseva, V. V. (Tula Polytechnical Inst., USSR). Metal Sci. Heat Treat. (USSR) (Engl. Transl.); 14: No. 5-6, 426-8(1972).

Translated from Metalloved. Term. Obrab. Metal.; 14: No. 5, 52-3(May 1972).

The effects of electrons on vacancy formation in steel were studied. It was found that the hardenability of steel after irradiation with relativistic electrons at austenite equilibrium temperatures and in the process of cooling increases substantially. The effect obtained indicates the formation of fairly stable pairs of vacancies and carbon atoms from excess vacancies of radiation origin and interstitial atoms of carbon, promoting stabilization of austenite. Vacancies formed during plastic deformation of austenite (high-temperature thermomechanical treatment) also may increase the hardenability of steel. (auth)

15310 EFFECT OF ALLOYING ON THE NEUTRON-IRRADIATION HARDENING OF COPPER. El-Shanshoury, I. A. (Atomic Energy Establishment, Cairo). J. Nucl. Mater.; 45: No. 3, 245-57(Dec 1972).

The effects of aluminum (2 to 18 at.%) and Si (2 to 8 at.%) solutes on the neutron-irradiation hardening of polycrystalline copper were investigated. The results were presented in different ways to study the superposition theory of irradiation and solution hardening for polycrystalline materials. It was found that the yield stress of irradiated Cu, Cu–Al and Cu–Si alloys is linearly dependent on the square root of the dose up to 2.85×10^{18} n/cm^2. The relation between the yield stress of the irradiated alloys (σ_i) and the fluence can be presented by the equation $\sigma_i = \sigma + B\,(\phi t)^{\frac{1}{2}}$. Both B and the exponent m of the relation $\sigma_i \propto (\phi t)^m$ remain constant up to a yield stress of 9.5 kg/mm^2 followed by a linear decrease, independent of the type of alloying elements. The constancy of B and m with the increase of concentration of Si (up to 5 at.%) and Al (8 at.%) or the yield stress of unirradiated alloys (9.5 kg/mm^2) indicated that the superposition model can be represented by the equation $\Delta\sigma_{iCu} + \Delta\sigma_A = \Delta\sigma_{iA}$ where $\Delta\sigma_{iCu}$ is the increase in yield stress of Cu due to irradiation, $\Delta\sigma_A$ is the increase in yield stress of Cu due to alloying and $\Delta\sigma_{iA}$ is the observed increase in yield stress of the irradiated alloys over that of Cu. The additivity is independent of the origin of the hardening effect, whether it is introduced by substitutional Al atoms or interstitial Si atoms. An increase of the Si and Al content affected the hardening rate of Cu at doses higher than 2.85×10^{18} n/cm^2. The hardening rate was found to decrease with increase in concentration. (auth)

15311 VISCOELASTIC ANALYSIS OF IN-PILE STRESS RELAXATION. Wolfe, R. A.; Hyatt, B. Z. (Bettis Atomic Power Lab., Pittsburgh). J. Nucl. Mater.; 45: No. 3, 181-94(Dec 1972).

A description of in-pile stress relaxation on the basis of a Maxwell–Kelvin linear viscoelastic model was developed from the assumption of a mechanical equation of state combined with creep characteristics observed in in-pile creep experiments. A previous proposal that in-pile stress relaxation can be represented by this viscoelastic model was further substantiated by an analysis of in-pile stress relaxation data for Almar 362, a maraging stainless steel. The data showed general agreement with the type of stress relaxation curves predicted by the model. In addition, consideration of the effect of strains introduced in the specimens prior to the in-pile relaxation helped to resolve an apparent discrepancy in the temperature dependence of different sets of Almar relaxation data. (auth)

15312 MODEL OF RADIATION-INDUCED STRENGTHENING OF SOLID SOLUTIONS. Orlov, A. N.; Rybin, V. V. (Ioffe Inst. of Physics and Tech., Leningrad). Fiz. Metal. Metalloved.; 33: No. 2, 253-6(Feb 1972). (In Russian).

A model for toughening a binary solid solution during low-temperature irradiation was based on different diffusion mobility of the internodal atoms of the two kinds. As a result, the more mobile internodal atoms yield at regional dislocations, so that the superstructural portions attain other parameters than the atomic planes, a different Burgers vector, and the original dislocations. The breaking away of a dislocation from the atomic plane of an anomalous width requires a supplementary stress compared with the order of magnitude with the observed increase of the flow limit of alloys during irradiation. (tr-auth)

15313 METHOD FOR REDUCTION OF LOSS OF HIGH-TEMPERATURE DEFORMABILITY ON AUSTENITIC HIGH-GRADE STEEL DURING REACTOR IRRADIATION. Pfeil, P. C. L. (to United Kingdom Atomic Energy Authority). German Patent 1,433,800. 6 Apr 1972. (In German).

A method was developed for the reduction of loss of high-temperature deformability of austenitic high-grade steel during reactor irradiation. It consists of alternating cold working and tempering steps which were carried out at 800 to 900°C with increasing tempering duration. In the final step the steel is subjected to cold working treatment. (GF)

Other Materials

Refer also to abstracts 14669, 14993, 16427, and 16511.

15314 (IAE–2131) RADIATION DOSE UNIT IN RADIATION STUDY OF MATERIALS. Karpukhin, V. I.; Alekseev, S. I.; Nikolaenko, V. A. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 10p. (In Russian). INIS.

The interaction of neutron radiation with matter is considered, and a control specimen is suggested for monitoring the reactor radiation and estimating the dose as related to the extent of radiation damage effected. Diamond was chosen as the standard substance. A new unit of radiation dosage is proposed as that amount of radiation which would result in an expansion of the natural crystal lattice of diamond by a factor of 0.001 at 100°C. (tr-auth)

15315 CHANGE IN ELECTRICAL RESISTIVITY OF NUCLEAR GRAPHITE DURING COMPRESSIVE TESTS. Eto, M.; Usui, T.; Oku, T. (Japan Atomic Energy Research Inst., Tokai). J. Nucl. Mater.; 45: No. 4, 347-350(Jan 1973).

The results of the measurement of electrical resistivity as well as optical micrography during compression of nuclear graphite are reported to show that the resistivity measurement technique is one of the methods by which the fracture mechanism of the material can be clarified. (TFD)

15316 VLIYANIE IONIZIRUYUSHCHIKH IZLUCHENII NA PROTSESS FLOTATSII. (Effect of Ionizing Radiation on the Flotation Process). Shafeev, R. Sh.; Chanturiya, V. A.; Yakushkin, V. P. Moscow; Izdatel'stvo Nauka (1971). 59p.

The influence of β- and γ-radiations on the flotation of apatite, antimonite, zircon, ilmenite, and other minerals was experimentally studied. The effects of these ionizing radiations on microhardness, electrochemical, and electrophysical properties of minerals and on the properties of water-pulp were studied. The intensification of ore flotation of minerals and similar material suspensions has been demonstrated. 64 references. (KSW)

15317 SINTERING OF URANIUM MONOSULPHIDE IN PRESENCE OF LIQUID PHASE. Pejovnik, S.; Komac, M. (Univ., Ljubljana, Yugoslavia). Mater. Res. Bull.; 7: No. 12, 1553-8(Dec 1972).

Uranium monosulfide, doped with various amounts of UOS, and in certain cases with BaS, was sintered at temperatures 1500 to 1950°C in an argon atmosphere. The additions of both UOS and BaS result in the formation of liquid phase, which was determined to be an US–UOS or US– $BaUS_2$ eutectic respectively. The presence of liquid phase greatly enhances the sintering of US in the temperature interval studied. (auth)

15318 BEHAVIOR OF THE CONCRETE IN REACTOR CONTAINERS IN THE PRESENCE OF THERMAL AND RADIATION STRESS. Cassinari, U.; Grassi, G.; Crispino, E. (Agip Nucleare SpA, Milan). pp 99-127 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

A cement conglomerate, called B.H.T., was developed for use at a maximum temperature of 500°C. The behavior under irradiation of BHT. was experimentally compared with that of standard concrete. The evolution of the resistance to compression as a function of the thermal treatment, the static modulus elasticity, the Poisson coefficient, and the thermal expansion were determined for standard and B.H.T. concretes. The results are shown graphically. The research program made it possible to individualize the principal factors responsible for the deterioration of the mechanical characteristics of the concrete because of the thermal treatment. In an appendix the existing pre-stressed concrete pressure vessels or those under construction are reviewed. (JSR)

15319 COLUMNAR GROWTH OF CARBON. Haanstra, H. B.; Knippenberg, W. F.; Verspui, G. (Philips Research Labs., Eindhoven, Netherlands). J. Cryst. Growth; 16: No. 1, 71-9 (Oct 1972).

It has been found that in the deposition of carbon by pyrolysis of carbon monoxide above 1800°C, a columnar growth of carbon is induced by β-SiC crystals, showing rotation twinning and stacking faults on {111}. The microstructure of the carbon columns can be visualized as being stacked from parallel layers of carbon atoms in a hexagonal graphite network, bent into a cone mantle with a top angle of about 141°. The successive layers are randomly rotated with respect to each other over angles being multiples of 60 or 30° divided by a prime number. The columns are thought to be generated on defects, by the topology of twinned β-SiC crystals and blocking of the sides by C–O bonds. (auth)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstracts 14966 and 16653.

15320 (AAEC/LIB/Bib-362) NUCLEAR MATERIALS MANAGEMENT AND SAFEGUARDS. A Bibliography. Geue, P. J. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Aug 1972. 95p. Dep. NTIS (U. S. Sales Only).

Five hundred and eleven references covering the period 1969 to Aug 1972 (NSA and INIS) are listed chronologically by year and alphabetically by author within each year. Part 1 contains conferences, books and bibliographies, part 2 contains safeguards systems analysis and safeguards objects, and part 3 contains safeguards techniques and instrumentation. (Australia)

15321 (Y-DR-79) RANDOMLY PULSED NEUTRON MEASUREMENTS FOR SAFEGUARDS INTERROGATION. Mihalczo, J. T. (Oak Ridge Y-12 Plant, Tenn. (USA)). 30 Nov 1972. Contract W-7405-eng-26. 24p. Dep. NTIS.

The applicability of measurements with a randomly pulsed neutron source using ^{252}Cf for safeguards interrogation has been investigated in a series of measurements with simple configurations of uranium metal, polyethylene, and stainless steel. The linear dependence of the total-time-correlated counts per californium fission on the ^{235}U enrichment of the uranium metal has shown that this method can be used for nondestructive assay determination provided measurements with standard samples of two ^{235}U enrichments are made. Accuracy of ±0.5% can be obtained in ~30 sec with a 3.2 μg ^{252}Cf source. Since the measurements can be made with detectors sensitive only to neutrons, this technique can be used for irradiated fuel. Other measurements of the time behavior of neutrons from fission chains in plutonium, which were also initiated by neutrons from spontaneous fission of californium, indicate that this method will also be useful for determination of the ^{239}Pu content of plutonium. (auth)

Disposal and Storage

Refer also to abstracts 14670 and 16583–16585.

15322 (BNWL-1701) HANFORD WASTE DISPOSAL SUMMARY: 1971. Soehnlein, J. H. (Battelle Pacific Northwest Labs., Richland, Wash.). Nov 1972. Contract AT(45-1)-1830. 19p. Dep. NTIS.

All waste releases were within RL Appendix 0510 Release Guides and were, with one exception, within 10% of the Guides. The only release which exceeded 10% of the Release Guide was an ^{131}I emission that occurred in mid-1971 from a Laboratory building in the 300 Area. Environmental measurements also demonstrated compliance with applicable environmental standards. Releases of radionuclides to air and water from 100 and 200 area facilities continued to show a downward trend, reflecting the effects of production facility retirement and the results of programs aimed at reducing releases. The one remaining single-pass production reactor, KE, was retired in January 1971. The discharge data for the short KE operating period are not included because of classification requirements. The quantities of wastes reported by the Hanford contractors for 1971 are presented in summary tabulations. (auth)

15323 (EUR-4903) SELF-BURIAL PROCESS OF CONTAINERS FILLED WITH HIGHLY ACTIVE RADIOACTIVE WASTE. Preliminary Report. Donea, J.; Giuliani, S.; Kestemont, L. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Nov 1972. 34p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 50,-.

This preliminary report shows on a theoretical basis how the decay-heat of fission products can be used to generate self-burial of appropriate containers filled up with radioactive wastes. Self-burial in salt domes is shown to be an interesting possibility. (auth)

15324 (IRS-T-23) MANAGEMENT OF DISPOSAL OF RADIOACTIVE MATERIAL FROM A NUCLEAR SITE. Institute for Reactor Safety Technical Meeting, Cologne, November 8–9, 1971. (Technischer Ueberwachungs-Verein e. V., Cologne (West Germany). Institut fuer Reaktorsicherheit). Jul 1972. 160p. (In German). (CONF-711146).

Five papers were presented at the conference. A separate abstract was prepared for each paper. (L.C.L.)

For abstracts of individual papers see: 15325, 16583–16585, and 16644.

15325 (IRS-T-23, pp 19-29) RADIATION PROTECTION STANDARDS FOR THE LICENSING OF DISCHARGE OF RADIOACTIVE SUBSTANCES FROM NUCLEAR INSTALLATIONS. Schwibach, J. (Bundesgesundheitsamt, Neuherberg, Ger.). Jul 1972. (In German).

From Institute for Reactor Safety technical meeting; Cologne, Germany (8 Nov 1971).

The general protection principles as stated in the international radiation recommendations and in the radiation protection ordinance of the Federal Republic of Germany lead to a restrictive authorization practice concerning the discharge of radioactive effluents from nuclear establishments. Thus, from the very beginning, the maximum permissible values for the dose of ionizing radiation or for the concentration of radionuclides in the environment which could be derived from these regulations had, to a large extent, not been reached. In the interest of a homogeneous practice of authorization in the Federal Republic of Germany, several technical limits have already been proposed in the past, to reduce the discharge of radioactive effluents. Recent discussions concerning both the genetically effective dose to the population from nuclear establishments and the individual exposure of persons in the vicinity of nuclear establishments to be used for planning purposes lead to further proposals for limiting radiation doses (radiation protection limits) which are to be taken as a basis for a homogeneous practice of authorization (e.g., an exposure of 30 mrem/year from gaseous radioactive effluents at a site of 10 mrem/year from radioactive liquid effluents via the drinking-water pathway in a river). The application of these radiation protection or technical limits in the authorization of nuclear establishments guarantees a large safety factor between the actual level of radiation exposure of the population and the dose limits of the radiation protection standards based on scientific results. (GF)

15326 (ORNL-4824) RADIOACTIVE WASTE REPOSITORY PROJECT. Annual Progress Report for Period Ending September 30, 1972. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 283p. Dep. NTIS.

Concerns about the long-term geologic stability of the salt formation at Lyons, Kansas, resulted in a search for an alternative site for the first radioactive waste repository and in a reassessment of the suitability of other geologic structures than salt for this purpose. It was concluded that salt formations continue to offer the best prospects; thus, following experimental confirmation of the suitability of a site, construction of a pilot plant repository in salt is planned for the early 1980s. If the results of operating this pilot plant are uniformly favorable, the facility may eventually be converted into a fully operational, permanent repository. The results of geological investigations at Lyons and the attendant investigations of alternative sites are summarized. Other topics included are: progress on the experimental phases of the program that are concerned with structural analyses of the geologic formation within which the repository may be located; studies of isotope transport by various mechanisms within the repository; considerations of the chemical and radiation effects near the buried wastes; calculations of the thermal conditions to be imposed as a consequence of waste burial; potential ecological effects; conceptual design studies of the pilot plant; and a description of the proposed pilot plant experimental program. (auth)

15327 (TID-3311(Suppl.4)) RADIOACTIVE WASTE PROCESSING AND DISPOSAL. (Technical Information Center (AEC), Oak Ridge, Tenn.). Jan 1973. 121p. Dep. NTIS.

References (464) are given to U.S. and foreign published articles, reports, and conferences published from 1968 through 1972. Separate corporate author, personal author, report number, and subject indexes are included. (PCH)

15328 EQUIPMENT FOR THE THICKENING OF RADIOACTIVE CONCENTRATES. Queiser, H. (to Licentia Patent-Verwaltungs-GmbH). German Patent 1,564,276. 20 Apr 1972. (In German).

A device for the thickening of radioactive liquid concentrates is described. It consists of a transportable container which takes up the contaminated concentrate, a radiator for the non-touching heating of the surface level of the concentrate, as well as auxiliaries for removing the evaporated liquid from the container. The heating element, an infrared radiator, can be inserted and extracted through an assembling support. (GF)

15329 DISPOSAL OF RADIOACTIVE WASTES. Schroeder, H. J. (Rheinisch-Westfaelisches Elektrizitaetswerk AG, Biblis,

Ger.). pp 218-42 of Jahrbuch der Dampferzeugungstechnik. Essen; Vulkan Verl. (1972). (In German).

Following some fundamental outlines on formation and treatment of radioactive materials in the nuclear power plant, concise explanation of the waste disposal between intermediate storage and final storage is given. Basic circuit diagrams of plants, numerical data on the release of radioactive wastes of the four German nuclear power stations VAK, KRB, KWL, and KWO as well as estimates of the radioactive wastes in the FRG by 1980 are also included. (GF)

Handling Equipment and Procedures

Refer also to abstract 14702.

15330 (ORNL-TM-3938) SAFETY ANALYSIS OF THE ALPHA ISOLATION LABORATORY, BUILDING 3508. Kappelmann, F. A.; Baybarz, R. D.; Rom, A. M.; Hickey, R. L. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 57p. Dep. NTIS.

The Alpha Isolation Laboratory, Building 3508, is a facility specifically designed for working with high-level alpha emitters. It is comprised of five containment laboratories and a Shielded Alpha-Gamma Cell. Supporting office and service facilities are also part of the building. The laboratories are equipped for handling high-level alpha and low-level beta-gamma emitting materials; the Shielded Alpha-Gamma Cell is designed for gram and microgram quantities of alpha and energetic neutron emitters, respectively. Ventilation of the building is arranged to provide a pressure gradient, ensuring that the air flow is from the office area to the relatively lower pressures of the regulated and contamination zones. Interiors of the glove boxes are served by a separate off-gas system to maintain a 0.35-in. H_2O (gage) pressure relative to the laboratory. Building 3508 serves as a research and development center for work with actinide elements, and includes necessary analytical facilities to support the main function of the building. (auth)

15331 CRYOGENIC VESSEL INTENDED PRINCIPALLY FOR TRANSFERRING IRRADIATED SAMPLES. Claudet, G.; Morin, H. (to Commissariat a l'Energie Atomique). French Patent 2,106,855. 5 May 1972. Filed date 25 Sep 1970. 7p. (In French).

A cryogenic vessel for the transfer of irradiated samples inside irradiation enclosures is presented. It consists of an inner envelope filled with a cryogenic liquid and an outer envelope. These two envelopes are coaxial and define an intermediate space containing the same cryogenic liquid. This space contacts the outside by the intermediate of orifices positioned in the upper part of the outer envelope. The device is also provided with a deflector which forms a bell whose upper part covers the two envelopes and whose side part surrounds the outer envelope such that the cold vapor of the cryogenic liquid coming from the inner envelope and the intermediate space absorb heat from the outside of the envelope. (France)

15332 TRANSFER LOCK. Lefrancois, J.; Marin-Dubuard, H. (to Commissariat a l'Energie Atomique). French Patent 2,112,082. 16 Jun 1972. Filed date 29 Sep 1970. 10p. (In French).

A transfer lock between two openings separating two adjacent sealed enclosures (glove boxes containing α or γ active objects or materials) is presented. The two enclosures are separated by a wall, which provides protection against γ radiation, and contains a communicating passage which can be shut off by a slab or shielded door sliding in a housing. The lock contains two cylindrical elements having a common axis, these elements being situated on either side of the sliding door. Both elements are fixed to their enclosures. A ring seal is provided between the outer surface of each element, the wall of the enclosure, and the housing of the sliding door. (France)

Transportation

15333 (DPSPU-69-124-1(Suppl.2)) SAFETY ANALYSIS REPORT LMF CASK FOR N-REACTOR FUEL (PACKAGING OF RADIOACTIVE AND FISSILE MATERIALS). Final Report. Evans, J. E.; Gates, A. A.; Scaggs, R. A. (comps.) (du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Plant). Jan 1973. Contract AT(07-2)-1. 38p. Dep. NTIS.

This supplemental report covers the shipment of approximately 800 kg of uranium in the form of ruptured N-Reactor (NPR) fuel in the LMF cask from Nuclear Fuel Services at West Valley, New York, to another reprocessing site. The original report, DPSPU-69-124-1, was for shipping ^{60}Co slugs. (TFD)

15334 (ORNL-TM-3468) ANALYSIS OF THE OAK RIDGE NATIONAL LABORATORY FOAMGLAS SHIPPING CONTAINER. Klima, B. B.; Shappert, L. B. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 90p. Dep. NTIS.

An analytical evaluation of the ORNL foamglas shipping container was made to demonstrate its compliance with the regulations governing packages in which radioactive material is shipped. Computational procedures were used to determine the structural integrity and thermal behavior of the container with respect to the general standards for packaging, structural standards, and the standards for normal conditions of transport. Destructive testing of the container demonstrated that the structural integrity and thermal behavior of the container met the standards for the hypothetical accident conditions. The results of this evaluation show that the container complies with the applicable regulations. (auth)

15335 NEUTRON SHIELDING PROBLEMS IN THE SHIPPING OF HIGH BURNUP THERMAL REACTOR FUEL. Bailey, H. S.; Evatt, R. N.; Gyorey, G. L.; Ruiz, C. P. (General Electric Co., Sunnyvale, CA). Nucl. Technol.; 17: No. 3, 217-224(Mar 1973).

An evaluation of the radiation from higher exposure light water reactor fuel that is of significance in shipping container design has been made. Because these fuels contain significant quantities of transplutonium nuclides, it has been established that the neutron emission rate and the associated biological dose rate is of large enough magnitude to require special consideration in the shielding design. This analysis is based on experimental determination of heavy element nuclide concentrations in both PWR and BWR fuel and the use of ANISN type shielding calculations. The results indicate that a conventional cask would not have sufficient neutron shielding capability to permit shipment of spent fuel with exposures in excess of approximately 22,000 MWD/MT. Hence, a new generation of shipping casks with specific provisions for neutron shielding is required. (auth)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 14846 and 16119.

15336 (BNL-17452) DEVELOPMENTAL STUDY OF PERSONNEL NEUTRON DOSIMETRY AT THE AGS. Distenfeld, C. H.; Klemish, J. R. Jr. (Brookhaven National Lab., Upton, N. Y.). 12 Dec 1972. 59p. (CONF-720614-5). Dep. NTIS.

From 17th annual meeting of the Health Physics Society; Las Vegas, NV (12 Jun 1972).

Neutron exposure at Brookhaven National Laboratory is primarily received by the occupants of the experimental facilities associated with the Alternating Gradient Synchrotron. The exposure field is composed mainly of neutrons and gamma rays of differing composition and energy spectra. Natural thorium fission track detectors and ^{6}LiF TLD materials are capable of responding to different parts of the neutron spectra. This provides a discrete response for each exposure spectrum. The personnel monitoring value of a fission track–TLD system depends on consistent dose equivalent reponse with field location. A multisphere Bonner neutron spectrometer was used to determine the maximum neutron dose equivalent. Concurrently, ^{232}Th fission track detectors and TLD (^{6}Li and ^{7}Li) were exposed. This procedure was repeated to establish the variation of calibration constants with field location. The constants weighted over field spectral variations are 3.5 mrem/spark for the Th fission track detector and 0.2 to 0.04 mrem/mR for the TLD difference detectors, depending on spectrum softness defined as TL to track ratio. The most significant difficulty in employing thorium fission track detection involves the radioactivity of the detector and the prejudice against monitoring exposure with a radioactive dosimeter. In this regard the fission track efficiency was studied with different foil thicknesses down to about one micron. It was observed that the production of fission fragments is optimum for foils of about 5 microns and thicker. The personnel exposure from a minimally shielded foil of about 5 microns thickness (5 cm^{2}) is about 1.3 to 2.1 mR/40 hour week at 0.5 cm for foils about 2 to 15 years old. (auth)

15337 (CONF-700929-(Vol.1)) PROCEEDINGS OF THE 1970 PROTON LINEAR ACCELERATOR CONFERENCE, SEPTEMBER 28–OCTOBER 2, 1970. Tracy, M. R. (ed.) (National Accelerator Lab., Batavia, Ill.). 1970. 633p. Dep. NTIS.

Separate abstracts were prepared for the 44 papers presented. (WHK)

For abstracts of individual papers see: 15338–15346, 15359–15382, 15405–15413, 15433, and 15434.

15338 (CONF-700929-(Vol.1), pp 15-27) CONSTRUCTION PROGRESS AND INITIAL PERFORMANCE OF THE NAL 200-MeV LINEAR ACCELERATOR. Young, D. E. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Construction of the first section of the NAL 200-MeV linac was started in May, 1968 as a prototype to test the design and to allow the development of subsystems required in the final linac. Protons were first accelerated in this section in June 1969. Construction of the final linac systems began in July 1969. Many of the prototype units were moved to the permanent linac building in January 1970. The first section (10 MeV) of the final linac operated in April 1970, the first three sections (66 MeV) in August 1970 and the first six sections (139 MeV) in September 1970. Initial performance data of these operating sections, problems experienced and design performance for the completed linac are presented. (auth)

15339 (CONF-700929-(Vol.1), pp 35-52) INJECTOR LINAC STUDY FOR JAPANESE PROTON SYNCHROTRON PROJECT. Baba, H.; Fukumoto, S.; Inagaki, S.; Kobayashi, M.; Nishikawa, T.; Okumura, S.; Tanaka, J. (Tokyo Univ.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The Japanese Proton Synchrotron Project will be financed from this fiscal year. The original plan was changed to an 8 GeV slow cycling machine with a 500 MeV booster and a 20 MeV linac as the injection scheme. Results from the design study for the injector linac; i.e., study on the ion source, development of the electroplating tanks, and experiments on the half-size model which was also tested by electron beams, are described. Electron beams as large as 100 μA, which is equivalent to about 180 mA of proton beam, can safely be accelerated. The result is consistent with the previous study on the longitudinal space charge effect. (auth)

15340 (CONF-700929-(Vol.1), pp 67-76) RUNNING-UP OF 10-MeV PROTON LINEAR ACCELERATOR AT SWIERK. Pachan, Marian (Inst. of Nuclear Research, Warsaw). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Individual technical features of various proton linacs make their running-up processes different in some aspects. The initial period of Swierk linac operation is briefly described, phenomena of multipactoring and high level breakdowns in the tank are discussed. It is understood as a fragmentary contribution to the general observations of RF discharges in linear accelerator structures. (auth)

15341 (CONF-700929-(Vol.1), pp 77-82) 10-MeV PROTON LINEAR ACCELERATOR AT SWIERK. Niewodniczanski, T. (Inst. of Nuclear Research, Swierk, Poland). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The Swierk linac is described and the main machine parameters are given. (WHK)

15342 (CONF-700929-(Vol.1), pp 83-97) INTERIM REPORT ON THE CONSTRUCTION OF THE LOS ALAMOS MESON PHYSICS FACILITY. Hagerman, D. C. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A description of the progress which has been made on the construction of the project prior to September 1970 is given. Some of the principal technical and administrative problems are discussed. (auth)

15343 (CONF-700929-(Vol.1), pp 99-105) ROUNDTABLE ON PERFORMANCE OF NEW LINACS. Wheeler, G. W. (Brookhaven National Lab., Upton, N. Y.); Batchelor, K.; Gluckstern, R. L.; Lefebvre, J. M.; Livdahl, P. V.; Swenson, D. A.; Taylor, C. S. 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

15344 (CONF-700929-(Vol.1), pp 175-84) OPERATION OF THE FIRST TANK OF LAMPF. Swenson, D. A. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The first tank of the Los Alamos Meson Physics Facility (LAMPF) is a 5 MeV drift-tube linac. It came into operation, along with its 0.75 MeV Cockcroft–Walton injector, on June 10, 1970. A general description of the operation since that time is given. (auth)

15345 (CONF-700929-(Vol.1), pp 217-38) OPERATION OF NAL LINAC AT ENERGIES TO 139 MeV. Curtis, C. D.; Dickson, J. M.; Goodwin, R. W.; Gray, E. R.; Livdahl, P. V.; Owen, C. W.; Shea, M. F.; Young, D. E. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The results of the 10-MeV prototype operation of last December are reported in the April 1970 issue of Particle Accelerators. Since that time, the first section of the linac has been installed and operated in the permanent linac building. With the addition of five more cavities, the linac has been operated at several energies up to 139 MeV. Measurements of beam properties are presented to show the new operating performance, principally at 10, 37, and 66 MeV. (auth)

15346 (CONF-700929-(Vol.1), pp 239-47) STATUS REPORT ON THE KARLSRUHE SUPERCONDUCTING PROTON ACCELERATOR. Citron, A. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A 60 MeV superconducting proton accelerator is being constructed at Karlsruhe as a pilot project for a larger proton accelerator. Parameters for the first part of the pilot accelerator are given and explained. (auth)

15347 (CONF-700929-(Vol.2)) PROCEEDINGS OF THE 1970 PROTON LINEAR ACCELERATOR CONFERENCE, SEPTEMBER 28–OCTOBER 2, 1970. Tracy, M. R. (ed.) (National Accelerator Lab., Batavia, Ill.). 1970. 549p. Dep. NTIS.

Separate abstracts were prepared for 31 of the 35 papers presented. Abstracts for the remaining 4 papers previously appeared as NSA 25: 7775, 7776, 9917, and 14853. (WHK)

For abstracts of individual papers see: 14765, 15348–15351, 15383–15391, 15414–15420, and 15435–15444.

15348 (CONF-700929–(Vol.2), pp 657-73) MECHANICAL DESIGN FEATURES OF THE NAL 200-MeV LINEAR ACCELERATOR. Palmer, M. L.; Mallie, F. J.; Sobocki, L. J.; Skraboly, A. E. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The design of the mechanical systems of the NAL 200-MeV linac were reported at the BNL Linear Accelerator Conference in 1968. Experience with the 10-MeV prototype cavity has resulted in a number of design changes. Details are presented regarding the fabrication of drift tubes, the adjustable cavity end plates including the half drift tubes mounted thereon, the cavity bulk tuners, the post couplers and their adjustment mechanisms, and the intertank system. (auth)

15349 (CONF-700929–(Vol.2), pp 919-48) RECENT AND PLANNED IMPROVEMENTS OF CONVENTIONAL ELECTRON LINACS. Loew, G. A.; Neal, R. B. (Stanford Linear Accelerator Center, Calif.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The status of existing and planned electron linacs is reviewed. The progress on development of superconducting electron linacs is not discussed except for a few remarks on the SLAC conversion program study. Progress in the superconducting area is being reported in other papers which are being presented at this conference. Because the SLAC accelerator is the largest existing electron machine and it is located at the authors' home institution, the main emphasis is given to reporting developments and plans at SLAC. The paper includes several recent ideas on the possible achievement of a somewhat higher duty cycle and/or higher energy from the SLAC accelerator by recirculation of the beam through the accelerator structure. (auth)

15350 (CONF-700929–(Vol.2), pp 973-80) ORSAY HEAVY ION ACCELERATOR (A.L.I.C.E.). Cabrespine, A.; Goldstein, C. (Institut de Physique Nucleaire, Orsay, France). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A status report on the Orsay cyclotron-linac combination is given, along with the results of a computer program, aiming to improve the grid focusing structure. (auth)

15351 (CONF-700929–(Vol.2), pp 981-92) GSI, A NEW HEAVY-ION RESEARCH FACILITY. Schmelzer, Ch.; Boehne, D. (Gesellschaft fuer Schwerionen-Forschung, Darmstadt, Ger.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The UNILAC project is now nearing its construction phase. Some information on the new organization is given and the general building conception is outlined. Arguments of structure selection are reviewed on the background of system reliability and of control philosophy. Recent investigations on the availability of parasitic beams are presented and a few remarks are given on the status of project development. (auth)

15352 (JINR–D1-6349, pp 632-40) PERSPECTIVES OF INVESTIGATIONS ON COUPLING WITH RELATIVISTIC ACCELERATED NUCLEI IN THE HIGH ENERGY SYNCHROPHASOTRON LABORATORY AT THE JOINT INSTITUTE FOR NUCLEAR RESEARCH. Baldin, A. M. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

New techniques in accelerator operation have uncovered interesting possibilities of this as a source of a beam of relativistic deuterons or of monoenergetic neutrons from a stripping reaction (up to 10^9 particles in a pulse). The spectra of secondary particles of high energy from a collision of relativistic nuclei was discussed, and mechanisms for transmitting a large amount of energy to a recoil nucleus were examined. (KSW)

15353 (LBL–996) RESULTS OF BEAM MEASUREMENTS AT THE SUPERHILAC. Selph, F. B.; Spence, D. A.; Stevenson, R. R. (California Univ., Berkeley. Lawrence Berkeley Lab.). Oct 1972. Contract W-7405-eng-48. 16p. (CONF-721046–15). Dep. NTIS.

From Proton linear accelerator conference; Los Alamos, NM (10 Oct 1972).

Beam studies which have been made so far have consisted of measurements of the beam as tuned up to deliver maximum beam to the experimental area. Studies have been made of (1) injector emittance and injection line transmission properties, (2) acceptance and transmission of the linac cavities, (3) measured emittance, and (4) tuning properties. With respect to studies that have been made so far, the SuperHILAC behaves about as expected. At an rf duty factor of 6%, a 7.2 MeV/A carbon beam of 1.1×10^{13} pps has a measured emittance of 0.9 cm mrad and a FWHM energy spread less than 1%. Raising the duty factor of 30% and adding a buncher will increase the intensity by at least a factor of 10. (auth)

15354 GENERATION AND DIAGNOSIS OF TERAWATT/CETIMETER^2 ELECTRON BEAMS. Condit, W. C. Jr. (Univ. of California, Livermore); Trimble, D. O.; Metzger, G. A.; (and others). Phys. Rev. Lett.; 30: No. 4, 123-5(22 Jan 1973).

Relativistic electron-beam current densities as high as 2.7 MA/cm^2 and power fluxes of 1.87 TW/cm^2 were generated and diagnosed on a pulsed electron-beam accelerator. The beam was field emitted from a 2-mm-dia glass cathode toward a transmission anode. Current densities were inferred by passing the beam through apertures as small as 1 mm and measuring the transmitted current with a Faraday cup. (auth)

15355 ACCELERATION OF HEAVY IONS IN A CYCLOTRON. Matsuda, Kazuhisa (Inst. of Physical and Chemical Research, Wako, Japan). Sci. Pap. Inst. Phys. Chem. Res. (Jap.); 66: No. 2, 33-38(Jun 1972).

In connection with the investigation of the acceleration of heavy ions, the characteristics of a system composed of an injector, a stripper, and a cyclotron are analyzed. It is revealed that the necessary magnetic rigidity of the cyclotron changes very slowly as a function of the energy of heavy ions injected. As a result, the cyclotron system with a certain maximum value of magnetic rigidity is able to amplify the particle energy by a constant factor, i.e., its output energy mainly depends on the injection energy and does not require a large change of magnetic field. If suitable injectors are provided, energy change of a wide range will be possible. (auth)

15356 ACCELERATION OF TRITIUM IONS ON THE IPCR CYCLOTRON. Shimamura, Akira; Tonuma, Tadao; Sakamoto, Ichiro; Kohno, Isao (Inst. of Physical and Chemical Research, Wako, Japan). Rikagaku Kenkyusho Hokoku; 48: No. 3, 69-75 (May 1972). (In Japanese).

Tritium ions were accelerated by the IPCR cyclotron at energies of 13 to 24 MeV. Since tritium is a radioactive element (β-decay, $E_{max.}$ = 18 keV), it is necessary to prevent escape of the gas to the atmosphere. The tritium gas was, therefore, circulated in a closed system including the acceleration chamber of the cyclotron, an evacuating pump, and a gas feeding part. The quantity of tritium leaking to the atmosphere was monitored with an ionization chamber of the collection type and a liquid scintillation counter. (auth)

15357 LINEAR RESONANCE ACCELERATOR WITH A CONTINUOUS FLOW OF ELECTRONS. Snedkov, B. A.; Turenko, B. A. At. Energ. (USSR); 34: No. 1, 55-56(Jan 1973). (In Russian).

The characteristics of a linear resonance high-frequency accelerator of monoenergetic electrons are outlined, based on the following principles. A field of circular sweep with a given frequency acts on an injected beam of a continuous homogeneous electron flux of low energy. An electron spiral with a constant pitch, formed as a result, enters the acceleration system—a spiral waveguide or a device of axially arranged ring-shaped traveling wave resonators. With the aid of an electrostatic or a magnetic focusing system, the three-dimensional spiral of accelerated electrons is converted into a rectilinear electron beam. Equations are presented which describe the action of the overall system and related energies. (2 figures) (KSW)

Auxiliaries and Components

Refer also to abstracts 14704, 14765, 14787, 14959, 15449, and 16319.

15358 (CERN-72-19) LOSS OF ENERGY PER UNIT AND OF DISTANCE FOR THE HEAVY IONS OF 10 MeV/NUCLEON TO 1000 MeV/NUCLEON. Richard-Serre, C. (European Organization for Nuclear Research, Geneva (Switzerland)). 9 Nov 1972. 263p. (In French). Dep. NTIS (U. S. Sales Only).

Accelerators can now accelerate heavy ions up to energies of around 1000 MeV/nucleon. Moreover, it is accepted that heavy ions of large Z and high energy of cosmic rays are responsible for a part of the biological damage in space. Therefore tables of energy loss by ionization and tables of path length for the ions are useful. (tr-auth)

15359 (CONF-700929–(Vol.1), pp 53-65) RADIATION SHIELDING AND SAFETY CONSIDERATIONS FOR THE NAL 200-MeV LINAC. Awschalom, Miguel; Gollon, P. J. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The basic philosophy of tolerable beam losses and hadron shielding requirements that guide the design of all radiation shielding at NAL is described. Also, data are presented to aid in estimating remanent exposure rates and shield thickness requirements. Penetrations to the linac enclosure, beam dumps and radiation safety interlock philosophy are presented, also. (auth)

15360 (CONF-700929–(Vol.1), pp 107-24) BEAM DIAGNOSTICS FOR THE NAL 200-MeV LINAC. Goodwin, R. W.; Gray, E. R.; Lee, G. M.; Shea, M. F. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The NAL Linac group decided, at the beginning of the project, to use the capabilities of the Sigma II control computer for the on-line acquisition, processing, and display of beam-diagnostic information. This decision has affected both the types of measurements which are feasible and design of instrumentation to perform the measurements. Some of the tasks implemented through the computer system include the readout of beam currents, beam-emittance measurements, and beam-profile measurements using both ion-collection and wire-scanning equipment. Using width information from three profile monitors, the emittance of the 10-MeV beam has been calculated and compared with slit-measured emittance values. The results of this comparison indicate that the profile monitor data can be used to determine the emittance at higher energies where destructive techniques are less attractive. The diagnostic equipment, software programs, and operating experience using these systems are described. (auth)

15361 (CONF-700929–(Vol.1), pp 125-42) AUTOMATIC ELECTRONIC EMITTANCE DEVICE FOR THE BNL 200-MeV LINAC. Witkover, R. L.; Fewell, N. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A system for the measurement of beam emittance has been designed and installed on the new BNL injector. It is similar in principle to the single slit-multiple collector device designed at NAL but does not require a digital computer. Emittance data are acquired, processed and displayed in a maximum of 100 beam pulses, which is ten seconds at the linac pulse rate. The data presented include a plot of the emittance and digital displays of the area, the threshold, the percentage beam at threshold and the number of beam pulses used. An alternate mode of beam profile display may be selected. The design of the electronic and mechanical components and some operating results are presented. (auth)

15362 (CONF-700929–(Vol.1), pp 163-73) 50-MeV BEAM MONITORING AT THE ZERO GRADIENT SYNCHROTRON (ZGS). Martin, R. L.; Trendler, R. C. (Argonne National Lab., Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The 50-MeV beam monitoring system at the ZGS has been made operational. It consists of vertical and horizontal nondestructive beam distribution measurements at four points along the beam transport line between the linac and the ZGS, and a horizontal position measurement in the middle of the achromatic injection system. The results are displayed on the computer display scope. The beam distribution measurements allow calculation of the beam emittance and can be displayed on a pulse-to-pulse basis to indicate changes in the emittance or beam steering. The position measurement in the achromatic system is an indication of the average energy of the beam. Initial operating results with this system are discussed. (auth)

15363 (CONF-700929–(Vol.1), pp 249-56) MEASUREMENTS ON A SUPERCONDUCTING HELIX. Vetter, J. E.; Piosczyk, B.; Mittag, K.; Hietschold, R. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Surface resistances of a Nb-helix as it will be used for a superconducting low energy structure were measured as a function of frequency. The results are compared to theory. An estimation of the surface resistance needed from the point of view of cooling with superfluid helium is given. The influence of a static magnetic field was also measured. (auth)

15364 (CONF-700929–(Vol.1), pp 257-63) MEASUREMENTS OF LOSS TANGENT OF DIELECTRIC MATERIALS AT LOW TEMPERATURES. Mittag, K.; Hietschold, R.; Vetter, J.; Piosczyk, B. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Dielectric materials can be used in superconducting linear accelerator structures for rf-feed through, support and tuning elements. RF-losses in insulators afford additional cooling power which is very expensive. Therefore, it is necessary to know the loss factor of insulating materials at the operation frequency and temperature. Measurements in the frequency range between 30 MHz and 300 MHz were performed in a superconducting helix resonator at 4.2 K and 1.9 K. Loss tangents down to $5 \cdot 10^{-8}$ for sapphire at 90 MHz and 1.9 K were measured. (auth)

15365 (CONF-700929–(Vol.1), pp 265-77) ELECTROMAGNETIC AND MECHANICAL PROPERTIES OF NIOBIUM CAVITIES FOR A SUPERCONDUCTING ELECTRON LINEAR ACCELERATOR. Herrmannsfeldt, W. B.; Helm, R. H.; Cochran, R. R. (Stanford Linear Accelerator Center, Calif.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Computer studies of the electromagnetic and mechanical properties of an S-band superconducting accelerator are described. The structure under discussion is intended for a test accelerator using a 15-cavity niobium traveling-wave resonant-ring structure operating in the $2\pi/3$ mode. Many of the parameters for this short test accelerator, such as the frequency (2856 MHz) and the accelerating field (33 MV/m), are the same as those proposed for the possible conversion of the SLAC two-mile long linear accelerator. The electromagnetic studies were made to optimize the various structure parameters including the quality factor Q, the shunt impedance r, the ratio r/Q, and the ratios of the peak-to-effective electric and magnetic fields. The resulting structure has a slight bulge at the disk tip and an elliptical cross section at the outer wall. The calculated values for the peak field ratios are $\hat{E}/E_{eff} = 1.66$ and $\hat{H}/E_{eff} = 31$ G/(MeV/m). A comparison of these and other parameters for different modes between $\pi/2$ and π is given. The mechanical studies were made to determine the frequency shifts due to deflection of the walls by the rf fields. Changes were made to the mechanical design and to the fabrication techniques during the study to minimize these frequency shifts. (auth)

15366 (CONF-700929–(Vol.1), pp 279-91) COMPUTATION OF THE PROPERTIES OF TRAVELING-WAVE LINAC STRUCTURES. Helm, R. H. (Stanford Linear Accelerator Center, Calif.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A computer program which calculates the properties of traveling wave linac structures has been developed. Quantities which are computed include field distributions, quality factor (Q), shunt impedance (r), group velocity (v_g), and ratios of peak fields to average accelerating field ($\hat{E}/E_{eff}$ and $\hat{H}/E_{eff}$). The computation is limited to cylindrically symmetric structures, but the cross section of the cell boundary is otherwise quite arbitrary. The phase shift per cell ($k_0 l$) may be chosen arbitrarily in the range $-\pi \leq k_0 l \leq \pi$. The program employs a functional expansion of the fields, rather than the mesh method. Expansion coefficients (A_n) and frequency (ω) are adjusted by the program to fit the boundary conditions according to the principle that the Lagrangian of the field should vanish as a function of ω and A_n, and should be stationary with respect to the A_n. Comparisons with experimental results and with results of other computer programs are presented for several structures. (auth)

15367 (CONF-700929–(Vol.1), pp 293-313) ACCELERATION OF LIGHT AND HEAVY IONS WITH HELIX STRUCTURE. Klein, H.; Siart, O. (Univ., Frankfurt am Main). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The problem of linac optimization with respect to the total RF-power is solved, giving simple mathematical expressions. A new method of calculating the current distribution on the helical waveguide and the RF-losses and the maximum magnetic fields on the surface of the helix is described. Some parameters of a superconducting Proton Helac, which shall be constructed in cooperation with the Kernforschungszentrum Karlsruhe, are discussed. For normal temperature relevant parameters of a Heavy Ion Helac are presented. This accelerator is proposed for post acceleration after a tandem machine (Emperor) as part of the projects planned by the GSI (Gesellschaft fuer Schwerionenforschung, Darmstadt). (auth)

15368 (CONF-700929–(Vol.1), pp 315-28) EXPERIENCES WITH POST COUPLER STABILIZED STRUCTURES IN THE NAL

LINAC. Owen, C. W.; Wildenradt, J. D. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The electrical characteristics of the first two linac cavities of the NAL linac that incorporate field-stabilizing devices have been determined. The measurements reported include the stability of the electric-field amplitudes as well as detailed field and other rf measurements at low power. (auth)

15369 (CONF-700929-(Vol.1), pp 329-42) NUMERICAL COMPUTATION OF FIELD DISTRIBUTION AND FREQUENCY IN THE LOWER PASSBANDS OF A SYMMETRICAL PERIODIC STRUCTURE. Bell, M.; Dome, G. (CERN, Geneva). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

In the past, relaxation methods have been used to compute the electromagnetic fields and the frequency of a periodic structure having a symmetry plane and rotational symmetry about its axis, at modes which are multiples of π. These computations involve determining one scalar function over a half-cell of the structure. It is shown that by determining two scalar functions over a half-cell of the structure, it is possible to compute by relaxation methods the electromagnetic fields and the frequency at any mode in the lower passbands of a symmetrical periodic structure, for a travelling wave as well as for a standing wave. All quantities of interest (shunt impedance, transit time factor, quality factor Q, and group velocity) may then be computed with good accuracy for any operating mode of the structure. Numerical results are given for the five lowest passbands of an Alvarez structure without stems, originally designed to accelerate protons at 18.737 MeV in its lowest 0 mode. (auth)

15370 (CONF-700929-(Vol.1), pp 359-70) MECHANICAL INSTABILITIES OF A SUPERCONDUCTING HELICAL STRUCTURE DUE TO RADIATION PRESSURE. Schulze, D. (Univ., Karlsruhe, Ger. Kernforschungszentrum, Karlsruhe, Ger.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The condition for mechanical instability due to radiation pressure is derived and the electro-mechanical coupling factor for a helical structure is calculated. The results are discussed with respect to the requirements of a superconducting proton accelerator. (auth)

15371 (CONF-700929-(Vol.1), pp 371-84) NAL LINAC CONTROL SYSTEM SOFTWARE. Goodwin, R. W. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A computer-based control system is being developed for the NAL 200-MeV linear accelerator. Software development is proceeding concurrently with the initial operating experience of the linac. Operator interaction includes the use of alphanumeric parameter displays with a keyboard as well as graphical displays of diagnostic data. On-line monitoring of accelerator parameters is provided. Operator control is implemented by a knob used in conjunction with a parameter display. Software organizational structure and operating framework of the system programs are described. Features of operating programs are discussed as they have been used during the early stages of linac operation. (auth)

15372 (CONF-700929-(Vol.1), pp 385-94) COMPUTER-BASED, DATA-ACQUISITION AND CONTROL SYSTEM FOR LAMPF BEAM DIAGNOSTICS. Machen, D. R. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A compact and highly versatile computer-based data system has been assembled in order to aid the beam-diagnostics effort at the Los Alamos Meson Physics Facility (LAMPF). A mini-computer, together with special peripheral control hardware and a LAMPF Data-Acquisition and Control Terminal (DACT), has given accelerator engineers and physicists the ability to control a portion of the accelerator and diagnostic hardware, while rapidly processing the experimental data. The design philosophy, system characteristics, and programming structure as applied to accelerator beam diagnostics are discussed. (auth)

15373 (CONF-700929-(Vol.1), pp 443-9) COMPUTER-STORAGE SCOPE DISPLAY INTERFACE. Donaldson, A. R.; Goodwin, R. W. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A computer interface for a graphical storage-tube display for operator control of the NAL linac is described. The technique allows X-Y point display with intensity control as well as X-Y point plotter hard copy. Conventional computer software generates binary data for the interface hardware. The interface controls the storage scope plotting through internal timing and sequencing circuits. X and Y point positioning for the scope and optional plotter is accomplished with interface digital-to-analog converters. (auth)

15374 (CONF-700929-(Vol.1), pp 451-69) COMPUTER MONITORING AND CONTROL SYSTEM FOR THE NAL 200-MeV LINAC. Anderson, E. W.; Lau, H. C.; Mehring, F. L. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The computer monitoring and control system is outlined in terms of the computer main frame, peripherals, interface equipment, vendor-supplied software, and control console. System-hardware philosophy and operation is discussed. Solutions of special interface problems such as those associated with the transmission of data across the 750-keV potential from source dome to ground are described. (auth)

15375 (CONF-700929-(Vol.1), pp 471-81) PHASE CONTROL AND FREQUENCY CONTROL OF 200-MeV LINAC FOR THE AGS. Weitman, I. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The phase control and servo controlled tuning of the 200 MeV linac at Brookhaven National Laboratory is described. The phase of the field in each cavity of the linac is coupled into the detection system through a probe at the approximate center of each cavity. Phase information is used for both the phase control and tuning control of the cavity. The phase of the cavity drive is controlled to maintain the desired phase relation to the reference. The frequency of the cavity is controlled by altering the penetration of a plunger tuner in the wall of the cavity. Each of these control systems is contained on a $4\frac{1}{2} \times 5$ inch printed circuit card with a standard 44 pin printed edge connector. Strip line techniques were used to bring the 200 MHz to and from the card. (auth)

15376 (CONF-700929-(Vol.1), pp 483-504) FULL POWER OPERATION OF THE LAMPF 805 MHz SYSTEM. Jameson, R. A.; Wallace, J. D.; Cady, R. L.; Liska, D. J.; Sharp, J. B.; Swain, G. R. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Results of system operation using the 1.25 MW, 805 MHz klystron rf amplifier and the side-coupled accelerator structure are reviewed from the several aspects of long and short term performance and the dynamic interaction between the amplifier and its load. Specific discussion of the latter aspect includes several new techniques for investigating detailed performance of accelerator systems operating under real, full-power conditions. (auth)

15377 (CONF-700929-(Vol.1), pp 505-13) SUMMARY OF THE BNL 200-MeV LINAC HIGH POWER RF SYSTEM AND ITS INITIAL OPERATING PERFORMANCE. Lankshear, R.; Keane, J.; McNerney, A.; Sheehan, J. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A brief description of the rf system and its components is given. Operational experience with the 10 MeV linac section and the introduction of high power into the third linac section are described. (auth)

15378 (CONF-700929-(Vol.1), pp 515-39) NATIONAL ACCELERATOR LABORATORY LINEAR ACCELERATOR RADIO-FREQUENCY SYSTEM. Mendenhall, D. I.; Winje, R. A. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The radio-frequency system for the National Accelerator Laboratory 200-MeV linear accelerator consists of nine 201.25 MHz pulsed-power amplifiers. Each power amplifier is hard-tube modulated and is rated at 5 MW peak power output. The characteristics of the equipment are described. The performance of the cavity accelerating field amplitude and phase-control servo systems under conditions of intense beam loading are discussed. (auth)

15379 (CONF-700929-(Vol.1), pp 541-50) 15-MW PULSE MODULATOR OF THE ARGONNE NATIONAL LABORATORY LINAC. Abraham, J. (Argonne National Lab., Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The new pulse modulator in the Argonne National Laboratory linac has just completed one year of operation. It is of the single-switch tube design that employs a dual, fast-acting fault protection system for the load. The modulator has a 0.5-μsec rise time,

which is obtained by a unique compensation scheme to reduce the effects of stray capacity. Design data and operating characteristics are discussed. (auth)

15380 (CONF-700929–(Vol.1), pp 551-9) PULSED POWER SUPPLIES FOR THE NAL LINEAR ACCELERATOR QUADRUPOLE MAGNETS. Goodwin, R. W.; Gray, E. R.; Lau, H. C.; Winje, R. A. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A current of 250 amperes in the quadrupole magnets used in the linear accelerator is required to provide focusing forces for the proton beam. A resonant-pulsed power supply with unique stability and pulse-shape characteristics is used to provide this current. The operational characteristics of the system including the control and monitoring of the magnet currents are discussed. (auth)

15381 (CONF-700929–(Vol.1), pp 561-77) QUADRUPOLE FOCUSING SYSTEM FOR THE 200-MeV LINAC. Damm, R.; Otis, A.; LoGrasso, V. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The construction and assembly of the drift tube quadrupole doublets for the BNL 200 MeV Linac and the LEBT (Low Energy Beam Transport) triplets are described as well as the flat top pulsed power system which provides a constant gradient during the 200 μsecond beam pulse. The overall system is controlled both in gradient and steering levels from reference signals supplied from the information system in the Injection Control Room. (auth)

15382 (CONF-700929–(Vol.1), pp 601-19) HIGH POWER RF TRANSMISSION LINE FOR THE 200-MeV LINAC AT AGS. Keane, J. T.; McKenzie-Wilson, R. B. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Brookhaven National Laboratory has chosen to use a 12'' coaxial transmission line system to connect the final 200 MHz amplifier to the accelerating cavity. The mechanical and electrical design, testing, development, manufacture and installation are discussed for all components of the system. Included is a three-quarter wave-length coaxial hybrid which is used as a Power Splitter, and, with the addition of End Shorts, as a Phase Shifter, a Variable Coupling Loop Assembly which is on the air side of the vacuum window, a Directional Coupler, and a Coaxial Elbow. The transmission line manufacture and installation are reviewed including the use of the tube flaring and welding fixtures. The complete installation and system checkout is also reviewed together with data on V.S.W.R., Coupling Coefficient vs rf drive loop penetration and voltage breakdown capacity. (auth)

15383 (CONF-700929–(Vol.2), pp 621-56) LINAC TANK INSTALLATION AND TUNE-UP FOR 200-MeV LINAC. Aggus, J.; Keane, J.; Grand, P. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The installation and set-up procedures for each tank are detailed as well as test results to date. Included are "Q" measurements with and without stems, tuner bar calculation techniques, the head perturbation system and results, projected power requirements for each tank and probe pick-up calibration. Tank fabrication and inspection procedures are outlined. The installation and alignment of tanks and drift tubes in the BNL linac tunnel are described. (auth)

15384 (CONF-700929–(Vol.2), pp 675-90) FABRICATION OF LAMPF LINAC STRUCTURES. Worstell, H. G. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Many of the LAMPF accelerator structure components were designed specifically to utilize assembly by hydrogen furnace brazing techniques. Equipment to perform this task has been installed, the techniques have been developed to a high degree and production of accelerator structures is well under way. (auth)

15385 (CONF-700929–(Vol.2), pp 691-8) VACUUM SYSTEM FOR BNL 200-MeV LINEAR ACCELERATOR. DiNaro, S.; Grand, P.; LoGrasso, V. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The vacuum systems for the pre-injector, low energy beam transport, accelerating tanks, and high energy beam transport are described. Details on pumps, pumping speeds, controls, instrumentation and power supplies are included. (auth)

15386 (CONF-700929–(Vol.2), pp 699-706) COOLING SYSTEM FOR THE NAL 200-MeV LINAC. Krzich, F. M.; Rihel, R. K. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The cooling system for the NAL 200-MeV linac consists of modular units which are designed for independent operation and control of all sections of the accelerator. The design criteria and operational characteristics of the systems are presented. (auth)

15387 (CONF-700929–(Vol.2), pp 707-18) MINERAL-INSULATED CONDUCTORS FOR MAGNET COILS. Harvey, A. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Data are presented on the characteristics of mineral-insulated (magnesium oxide) copper conductors developed for high radiation environments. Two conductor types are described, a solid conductor which can be cooled externally, and a hollow, direct-water cooled conductor. In the solid conductor designs, the thermal conductivity of the insulation is dominant, and data are presented on attainable current densities. For hollow conductors, specifications are presented for a range of sizes, which include manufacturing limits adapted to the inherently irregular shape of the conductor. Examples of mineral-insulated coils are illustrated. (auth)

15388 (CONF-700929–(Vol.2), pp 719-31) ALIGNMENT OF TANKS AND DRIFT TUBES FOR THE NAL 200-MeV LINAC USING A LASER LIGHT BEAM. Palmer, M. L.; Hogan, J. D. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The equipment, fixtures, and techniques used in aligning the tanks and drift tubes of the NAL 200-MeV linac are described. An alignment optical laser is used and targets are placed in the drift tubes to allow readout during positioning. Reference lines established external to the linac tanks permit periodic realignment of the tanks without future reference to the drift-tube positions. (auth)

15389 (CONF-700929–(Vol.2), pp 1095-1105) SYSTEM FOR TRANSPORT AND ANALYSIS OF 200-MeV LINAC BEAM. Hubbard, E. L.; Martin, W. C.; Michelassi, G.; Peters, R. E.; Shea, M. F. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The 200 MeV beam from the NAL linac will be steered along either of two beam lines. One beam line will be used to transport the beam from the linac to the inflector of the booster synchrotron. This line will be 65 m long. It includes a vertical translation from the linac elevation to the booster elevation and quadrupoles for matching the beam to the booster acceptance. The other beam line will be used for analysis of the linac beam. Emittance will be measured with three beam profile monitors located in a line straight ahead from the end of the linac. Momentum spread will be monitored by deflecting the beam 40° with a magnet and measuring the width of the dispersed beam. Switching the beam between the transport and the analysis lines will be done with a pulsed electrostatic deflector followed by a septum magnet in order to permit selecting the duration of the beam pulse transmitted to the booster over the range from 1 μsec to 100 μsec. Linac beam not transmitted to the booster will be stopped in a beam dump in the analysis system. (auth)

15390 (CONF-700929–(Vol.2), pp 1107-17) HIGH RESOLUTION HIGHLY SENSITIVE NONINTERCEPTING BEAM PROFILE MONITOR FOR THE LOS ALAMOS MESON FACILITY (LAMPF). Hornstra, F. Jr. (National Accelerator Lab., Batavia, Ill.); Trump, M. 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A high resolution, highly sensitive, nonintercepting beam profile monitor is described. Calculations show that profiles of 1 mm and 1 cm diameter beams may be measured with less than 0.05 mm and 0.1 mm error respectively. Signal is derived from primary beam ionization of the residual gas molecules in a vacuum. Parallel, homogeneous electric and magnetic fields are utilized in guiding the liberated electrons to image the beam cross section precisely on a detector. A slit defines the resolution and the beam profile is acquired by mechanically moving the slit and detector across the image. Alternatively, the image may be moved across a stationary slit by simply shifting the magnetic field. The high sensitivity necessary for the LAMPF H^- beam is achieved with a detector consisting of a phosphor on a photomultiplier tube. The lower level of beam current for which a profile is measurable is determined by the rate at which the profile is scanned and the statistics required. (auth)

15391 (CONF-700929-(Vol.2), pp 1133-40) DRIFT TUBE ADJUSTMENT IN AN EVACUATED ALVAREZ LINAC. Chidley, B. G.; Bayly, J. G. (Atomic Energy of Canada Ltd., Chalk River, Ont.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Measurements of drift tube positions in an evacuated linac tank are difficult and the final adjustments are usually made before final assembly. Scale model experiments indicate that measurements of the tank's resonant frequency, which reaches a maximum when the tube spacings have their design values, permit longitudinal adjustments to be made after the structural changes caused by evacuation have taken place. Only the frequency change needs to be observed; the adjustments are made to the external drift tube support stems while the tank is under vacuum. Because of the interaction of each tube with its neighbors, repeated adjustments of all tubes in sequence were necessary. A tank containing 22 drift tubes required six passes. The possibility of obtaining quicker convergence by using a computer to predict the final adjustments from the frequency shifts observed in an initial optimization was examined. Second order interactions made this impractical and unnecessary considering the simplicity and reliability of the direct method. (auth)

15392 (JINR-P16-6790) COMPARISON OF VARIOUS METHODS AND RADIATION PROTECTION INSTRUMENTATION APPLIED TO RADIATION FIELDS OF THE JINR PROTON ACCELERATORS. Aleinikov, V. E.; Arkhipov, V. A.; Vinogradov, V. F.; Komochkov, M. M.; Mokrov, Yu. V.; Salatskaya, M. I.; Cherevatenko, A. P. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

The confidence degree is determined to the indications of radiation protection instrumentation and methods currently used for dosimetry control in the mixed radiation fields behind the shielding of the JINR proton accelerators. The devices for the routine dosimetry control reproduce the dose equivalent of radiation with the accuracy to coefficient 2. Overestimation of the dose equivalent for personnel neutron dosimeter by more than two times occurs in such radiation fields where the relativistic neutron contribution to the total dose equivalent of radiation exceeds 10%. (auth)

15393 (JINR-P16-6791) NEUTRON SPECTRA OUTSIDE THE PROTON ACCELERATOR SHIELDING. Aleinikov, V. E.; Gerdt, V. P.; Komochkov, M. M. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The method of determining the proton high-energy accelerator shield-leakage spectra is developed. Neutron energy spectra outside the shielding of proton high-energy accelerators at the JINR are presented. (auth)

15394 VACUUM-TIGHT GLUING OF PLASTIC TO STAINLESS STEEL. Meskhi, G. O.; Sidorov, V. B. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 488-489(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 157-158(1972).

A method is described for gluing large plastic parts to stainless steel using PU-2 glue in the fabrication of high-voltage insulators. A drawback of this glue is its toxicity. (1 figure) (auth)

15395 OPERATION OF A ROGOWSKI LOOP IN MEASURING THE CURRENTS OF PULSED BEAMS HAVING A NANOSECOND DURATION. Vasserman, S. B. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 415-419(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 99-103(1972).

The theory of operation of a Rogowski loop—a current transformer—in the nanosecond range of pulse lengths where the quasistationarity condition is usually not fulfilled is considered. The basic data are presented, and the construction of a meter for measuring the current of an electron beam at amplitudes of tens of kiloamperes for a pulse length of 40 to 50 n on the RIUS-5 accelerator is described. (auth)

15396 COMPUTER CONTROL OF PARTICLE ACCELERATORS. Kamei, Tohru (National Lab. for High Energy Physics, Oho, Japan). Oyo Butsuri; 41: No. 3, 274-280(Mar 1972). (In Japanese).

A major part of accelerator control is repetition of simple operations, except for start-up. The number of operators can be reduced by making a computer perform the simple operations; reliable operations may therefore be expected over a long period. Computers may be employed on an on-line basis for the control of large accelerators. Though proper measures are now taken by operators at important points because of complexity, control has become easy and operational efficiency has been rapidly improved by the introduction of computers. A number of technical problems concerning computers, multiplex systems, A-D conversion, power source regulators, and interfaces are discussed. It is emphasized that the CAMAC system is now employed in the accelerator control systems of every country in the world. (Japan)

15397 CRYOGENIC PUMPING EQUIPMENT FOR A HIGH POWER ACCELERATOR. Hourst, J. B.; Roche, M. (Centre d'Etudes de Valduc, Is-sur-Tille, France). Vide; No. 157, Suppl., 8-12(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

The different devices used to maintain the vacuum in a very-high-power, low-energy (150 to 250 keV) electrostatic accelerator intended for the production of a very intense neutron flux (14-MeV neutrons) are described. The vacuum system, which has a very high pumping speed, produces a completely hydrocarbon-free vacuum and is provided with a means of recovering the pumped gases. (France)

15398 PUMPING HYDROGEN WITH THE 614 HISPANO-SUIZA TURBOMOLECULAR PUMP. Bernard, P.; Bony, J.; Rommel, G. (CEN de Saclay, Gif-sur-Yvette, France). Vide; No. 157, Suppl., 233-8(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

The pumping speed for hydrogen of the 614 Hispano-Suiza pump was measured, and the compression ratios of the pump operating with this gas and with nitrogen were compared. The studies were performed in view of applications to a polarized particle pre-accelerator. The utilization of turbomolecular pumps for pumping hydrogen requires enhanced primary pumping. An improvement might be achieved by increasing the rotation speed. (France)

15399 CONTINUOUS PUMPING OF HYDROGEN WITH AN ION PUMP. Chamouard, P. A.; Rommel, G.; Thomas, R. (CEN de Saclay, Gif-sur-Yvette, France). Vide; No. 157, Suppl., 239-44(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

Tests carried out on a sputter ion pump intended for the pre-injector of the Saturne accelerator tube are presented. Continuous pumping of hydrogen at pressures of the order of 10^{-6} torr can be ensured with this pump. The type of operation taking place (formation process) leads to a doubling in the flow rate after a period of a few dozen hours. (France)

15400 HIGH-FREQUENCY QUADRUPOLE-FOCUSSING SECTIONS OF A LINEAR ACCELERATOR. Il'evskii, S. A.; Kapchinskii, I. M.; Kuznetsov, G. F.; (and others). At. Energ. (USSR); 34: No. 1, 56-58(Jan 1973). (In Russian).

The application of high-frequency quadrupole field focusing for improving the performance of a linear ion accelerator is discussed. Fundamental parameters of such a section are given: a pre-injector assures a current of up to 100 mA at the section input, which is measured by an induction transducer; the output is measured by a Faraday cylinder. The construction of a small-sized proton accelerator is much simpler than the common Alvarez accelerator with the same physical parameters. In the section there is a large reserve of electrical stability of the accelerating gaps. The performance of the section is evaluated graphically. (KSW)

15401 BLOCKS FOR SPECIFYING THE CONSTANTS AND FOR INTERFACING THE TPA ELECTRONIC COMPUTER WITH THE CASSETTE IN THE CAMAC STANDARD VIA THE PROGRAMMING CHANNEL. Kolpakov, I. F.; Nikityuk, N. M. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 710-712(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 84-87(1972).

The construction and block diagrams of devices for interfacing (the Type 611 controller) the cassette in the "CAMAC" standard with the TPA electronic computer via the programming channel are described, as well as two blocks of Type 511 and 512 for specifying the constants. The interface is designed for measuring the parameters of the JINR synchrotron. (auth)

15402 MULTICHANNEL ANALYZER FOR RAPIDLY VARYING FREQUENCIES. Mikhailichenko, A. A.; Turkin, V. F.; Fishman, I. S. (Inst. of Nuclear Physics, Novosibirsk, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 745-751(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 115-118(1972).

A three-channel amplitude analyzer for rapidly varying frequencies is described which allows the dynamics of the development of coherent wave instability in accelerators to be traced during one cycle of the order of milliseconds. (auth)

15403 OPERATIONS OF A CYCLOTRON IN A MODE WITH A REDUCED REPETITION FREQUENCY OF THE PARTICLE BUNCHES. Atlashkin, N. N.; Okorokov, V. V.; Serezhin, V. M.; (and others) Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 634-636(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 20-22(1972).

A system is described which is used to reduce the repetition frequency of bunches of accelerated particles by a factor of two on the cyclotron at the Institute of Theoretical and Experimental Physics. Control of the extracted beam is achieved by means of a high-frequency sinusoidal voltage applied to the deflector plate of the cyclotron. (auth)

15404 EXPERIMENTAL CHARACTERISTICS OF A SECONDARY-EMISSION ACCELERATED-ELECTRON-BEAM MONITOR. Angelov, B. P.; Prudnikov, I. A.; Shchepin, Yu. P. (Scientific-Research Inst. of Electrophysical Equipment, Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 637-639(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 23-24(1972).

The construction of a three-foil secondary-emission current monitor is described; its volt-ampere characteristic and the dependence of the yield of secondary electrons on the current density and energy of the beam electrons are displayed. It is shown that the yield of secondary electrons from the emitting foil remains practically unchanged in the beam-electron energy range from 6.4 to 9.5 MeV and does not depend on the beam-current density right up to the maximum investigated density ~0.95 A/cm^2. (auth)

Ion Sources and Injection and Extraction Systems

15405 (CONF-700929-(Vol.1), pp 1-14) STATUS OF THE BNL 200-MeV INJECTOR LINAC. Wheeler, G. W. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The 200-MeV proton linac injector for the AGS is nearing completion. The preinjector and first accelerating cavity have accelerated over 200 mA to 10.4 MeV. The current status of the linac installation is outlined. (auth)

15406 (CONF-700929-(Vol.1), pp 29-33) OPERATION REPORT OF THE SATURNE LINAC INJECTOR SPACE CHARGE COMPUTATION RESULTS. Lefebvre, J. M.; Prome, M. (CEN, Saclay, France). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The results of a one year activity in two fields are reported: operation of the 20 MeV linac injector of the Saturne proton synchrotron and calculations of space charge effects on linac beam qualities. (auth)

15407 (CONF-700929-(Vol.1), pp 143-61) INITIAL OPERATION OF THE BEAM-TRANSPORT SYSTEM IN THE LAMPF INJECTOR COMPLEX. Allison, P. W.; Emigh, C. R.; Stevens, R. S. Jr. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The high-intensity proton beam line in the LAMPF injector complex has been constructed and is now in operation. This beam line, which is part of the planned dual beam transport system, employs four bending magnets and six quadrupole focusing lens systems in order to transport 750-kV proton beams a distance of 12 meters from a Cockcroft–Walton (C–W) high-voltage generator to the first tank of a drift-tube linac. The beam line is capable of transporting beams of 50-mA current with several cm-mrad emittance. Of particular interest is the use of quadruplet matching elements in order to obtain more versatile beam handling and the use of two buncher cavities for longitudinal phase space matching to the linac. A variety of beam diagnostic devices and automatic control systems has been planned for use in the beam line. The results of initial operation and beam measurements are presented. (auth)

15408 (CONF-700929-(Vol.1), pp 185-215) BEAM PERFORMANCE OF THE 10-MeV SECTION OF THE 200-MeV LINEAR ACCELERATOR AT BROOKHAVEN NATIONAL LABORATORY. Batchelor, K.; Bittner, J.; Chasman, R.; Fewell, N.; Sluyters, T.; Witkover, R. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Performance of the new 10-MeV linac and its low energy transport system is illustrated by means of partial emittances, intensities, density distributions and energy and phase spreads. Special emphasis is put on the influence of space charge on the transverse and longitudinal properties of the beam. Comparison is made between experimental data and computational results. (auth)

15409 (CONF-700929-(Vol.1), pp 395-404) DIGITAL TIMING AND SYNCHRONIZATION SYSTEM FOR THE BROOKHAVEN 200-MeV LINEAR ACCELERATOR. Pyros, I. E.; Rosenfeld, A. (Brookhaven National Lab., N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Utilizing up-to-date in-line integrated circuits and state-of-the-art packaging techniques, a digital building block is described and incorporated in the design of a timing and synchronization system. Unique circuits are analyzed and discussed for minimizing fabrication and maintenance. Some preliminary conclusions are presented which were obtained from the prototype timing system. (auth)

15410 (CONF-700929-(Vol.1), pp 405-21) LINAC CONTROL SYSTEM AC TURN ON FOR 200-MeV LINAC. Greenberg, D. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The general machine philosophy is presented and detailed for the AC turn on, monitoring and control of the 200 MeV Linac. Three major control points are set up to run the linac. The Injector Control Room (ICR) for overall linac control; the Local Control Stations (LCS) for module control; the Sub-Module Control Points for turning on individual equipment. Personnel safety interlocking is provided. Solid state logic and printed circuit card construction is utilized. Summary status information is displayed at control points so that a minimum number of control wires may be utilized. (auth)

15411 (CONF-700929-(Vol.1), pp 423-42) DATA ACQUISITION AND DISPLAY SYSTEM (DACADS) FOR THE 200-MeV LINAC AT THE AGS. Weitman, I.; Brown, M. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The system described is in accordance with the ground rules covering overall control of the linac. The function of DACADS is to make available to each subsystem a dc reference voltage representing the operating point of that sub-system. Each subsystem can be interrogated by the Local Multiplex Unit of DACADS and the data thus obtained displayed at the ICR. A D.E.C. PDP-8/L Computer is located in the ICR and interrogates the individual LCS's and stores this data. The executive program periodically scans this data and processes it for display on five dedicated purpose display scopes. In the event of a failure of the Computer or Injector Control Room equipment, each Local Control Station remains functioning and has complete control of all individual references. If one Local Control Station should fail the other LCS's are still under the central control of the ICR and the one station which has failed can be manually controlled. (auth)

15412 (CONF-700929-(Vol.1), pp 579-90) TELEMETRY SYSTEM FOR THE ZERO GRADIENT SYNCHROTRON (ZGS) ION SOURCE TERMINAL. Lewis, L. G.; Timm, R. E. (Argonne National Lab., Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

An optical telemetry system provides for transmission of analog and digital signals from the preinjector ion source equipment enclosure to the ZGS Main Control Room. The analog channel employs a frequency modulated light beam to transmit pulse shapes that have rise times as fast as 0.6 μsec and that last for several hundred microseconds. Any one of the analog signal sources can be selected from the Main Control Room. The digital channel employs pulsed light beams to transmit information to and from the high voltage terminal. The digital measurements of source parameters are made on command from the ZGS control computer and the results are transmitted to the computer. At present, the digital system can handle as many as 24 signal sources. (auth)

15413 (CONF-700929-(Vol.1), pp 591-600) TELEMETRY OF CONTROL AND MONITORING SIGNALS ACROSS A HIGH-VOLTAGE INTERFACE USING LIGHT LINKS. Donaldson, A. R. (National Accelerator Lab., Batavia, Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The infrared fiber-optic light-link telemetry system used between the ground station and the high-voltage terminal of the NAL 200-MeV linac preaccelerator is described. The several systems that have been used are compared with respect to frequency re-

sponse, transmission attenuation, and reliability. Applications covered include pulse, digital, and video coupling. (auth)

15414 (CONF-700929-(Vol.2), pp 993-1006) ANL 750-kV HIGH GRADIENT ACCELERATING COLUMN. Perry, Rolland (Argonne National Lab., Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A high gradient accelerating column has recently been installed in the ZGS preaccelerator. This operates at 750 kV across a single accelerating gap. The beam from a duoplasmatron ion source is extracted from a ½'' diameter plasma expansion cup by the field of the main accelerating gap. Thus lens aberration is minimized by complete absence of lens elements except at the extraction surface and at the exit aperture of the accelerating tube. Beam currents of 375 mA have been obtained. Typical operation is with a 200-mA beam pulse of 150–200 μsec duration, for which the normalized emittance is about 0.19 mrad/cm for 90% of the beam. Two electrostatic quadrupole triplets of 4'' aperture focus the beam from the accelerating tube into the beam buncher, and a magnetic triplet is used for matching into the linac. (auth)

15415 (CONF-700929-(Vol.2), pp 1007-25) TEST OF LASL ION SOURCE WITH 750-kV ACCELERATING COLUMN. Emigh, C. R.; Meyer, E. A.; Mueller, D. W. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The 750-kV high-intensity injector for the LAMPF accelerator has been constructed and was put into operation on June 9, 1970. Specifications were met by a 25-mA pulsed beam of protons, 500 μsec in length with a repetition rate of 120 Hz, and a beam emittance area less than 2π cm-mrad. The ion source is a Von Ardenne duoplasmatron with a 1.4-cm diam expansion cup. The column operates at 750 kV and has an exact Pierce geometry extraction system. The ion source is operated at +750-kV level by light-link control from ground level equipment. The system is capable of conversion to computer control when computer operation becomes available. Hydrogen pumping is accomplished by ion pumps operating at both ends of the accelerating column. The exact Pierce geometry of the accelerating column is formed by shaped Ti alloy electrodes, with an electrostatic electron trap built into the column at the high-energy end. High-voltage insulation is accomplished by an acrylic jacket filled with SF_6 at 6 psig. Unique features of the jacket are its transparency for observing corona and spark discharges, and its nine access ports for ease of assembly and maintenance of the accelerating column. (auth)

15416 (CONF-700929-(Vol.2), pp 1027-53) PROPOSAL FOR A HIGHER ENERGY PREINJECTOR FOR THE CERN P.S. Bernard, P. (CEN, Saclay, France); Huguenin, J.; Tallgren, U.; Weiss, M. 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A paper on the: "Preliminary Study of a Higher Energy Preinjector for the CERN PS'' was presented at the 1968 Brookhaven Conference, in which the expected improvements in the Linac beam to follow such a change were discussed. The continuation of the study produced some interesting results which are the subject of the present paper. These include high voltage tests (to 1.2 MV) on the CERN high gradient accelerator tube, ion optical calculations, and proposals for the design of the HT generator. It is concluded that it seems feasible, taking a reasonable technological risk, to construct a pressurized 500 mA preinjector with a final energy of 1.4 MeV. Details of the layout of such a preinjector are included. (auth)

15417 (CONF-700929-(Vol.2), pp 1055-65) TANDEM ACCELERATION HIGH INTENSITY H^- ION SOURCE. Fasolo, J. A. (Argonne National Lab., Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A source capable of providing at least 10 mA of H^- ions for injection into the linac, after acceleration to 750 keV, is required for the Zero Gradient Synchrotron (ZGS) booster injection program. A tandem acceleration ion source is being developed to satisfy this requirement. The source is theoretically capable of producing a measured current of 20 mA but has not yet done so. The largest currents obtained to date have been limited to about 10 mA for reasons which appear to be related primarily to H^- beam attenuation due to stripping in the beam analysis chamber, which separates the H^- source from the ion pump chamber in the geometry under consideration. Gas flow into the plasma source is continuous; outflow may be continuous or pulsed. Reduction of the average flow to 1 cm^3/min(760 Torr, 20°C) or less is a prerequisite for operation in the 750-keV terminal of the preinjector, where space and power for a conventional high speed, large capacity pump are not available. (auth)

15418 (CONF-700929-(Vol.2), pp 1067-73) NEW BOUNCER FOR A HIGH GRADIENT COLUMN. Abraham, J. (Argonne National Lab., Ill.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A new fast regulator (bouncer) for use with the high gradient column in the ZGS preinjector has been designed and constructed. It is designed to operate in a closed loop to regulate the loading effects of 200 to 500 μsec, 300-mA beam pulses, the low frequency regulation being provided by the previously employed bouncer. The system operates with a small coupling capacitor and a high value of decoupling resistance in order to keep the sparking energy low. (auth)

15419 (CONF-700929-(Vol.2), pp 1075-85) DESIGN CONSIDERATIONS FOR A 200-MeV PROTON BEAM TRANSPORT SYSTEM. Claus, J. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The design of the beam transport system (HEBT) between the new 200-MeV injection linac and the AGS at Brookhaven National Laboratory involved consideration of the following points: physical situation, requirements of the AGS in terms of beam emittance and energy spread, characteristics of the linac beam and space-charge effects. The design adopted was strongly affected by space-charge effects. It consists of a nearly periodic focusing structure with gradually increasing betatron wavelength, a momentum recombining (achromatic) bend, a matching section for emittance adjustment and a double bend of which the magnetic AGS inflector is the last part. A debuncher system will be available and it is proposed to tune it in combination with the linac to yield bunches with a phase spread of about π radians and an energy spread of a few hundred keV or less. Space-charge effects are expected to become noticeable in the form of emittance blow-up in the proposed system for 100 mA beams with emittance of less than 0.2π cm-mrad. (auth)

15420 (CONF-700929-(Vol.2), pp 1087-93) EMITTANCE MEASUREMENT IN A 200-MeV BEAM TRANSPORT SYSTEM. Claus, J.; Sluyters, T. J. M. (Brookhaven National Lab., Upton, N. Y.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Optimum positions for beam profile monitors for beam emittance measurement in the high energy beam transport (HEBT) system between the 200-MeV conversion linac and the AGS at Brookhaven National Laboratory are considered. Also, some characteristics of possible profile monitors are studied. (auth)

15421 (DESY-DV-72/1) USE OF AN ARGUS 500 COMPUTER TO SUPPORT THE OPERATION OF A LINEAR ACCELERATOR. Dahlmann, K.; Ehrig, J.; Heil, O. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1972. 19p. Dep. NTIS (U. S. Sales Only).

An ARGUS 500 computer control system for control of the electron (or positron) linac injector for DESY is described. (WHK)

15422 (DNPL/NSF/R-1, pp 1-8) PRINCIPLES OF POLARIZED ION SOURCES. Powell, W. B. (Univ. of Birmingham, Eng.). 1972.

From Symposium on polarized beams; Daresbury, England (10 Jan 1972).

A brief account is given of spin orientation and of the two main types of sources of polarized particles: the so-called conventional or molecular beam source whose primary output is a polarized positive ion, and the Lamb-shift or charge exchange source whose primary output in the case of protons and deuterons is a negative ion. The prospects for improving sources are considered, with the position in the United Kingdom particularly in mind. (UK)

15423 (DNPL/NSF/R-1, pp 9-25) POLARIZATION TRANSFER FROM AN ATOM TO ITS NUCLEUS. Oh, S. W. (Univ. of Birmingham, Eng.). 1972.

From Symposium on polarized beams; Daresbury, England (10 Jan 1972).

The basic principles involved in the production of a polarized atomic beam source are examined theoretically and experimentally, with particular reference to a polarized deuterium source. The effects on the spin states of the atom, of passing the beam from a dissociator through the powerful magnetic field of the special sextupole magnet, and then through an ionizer, are reviewed in detail. (UK)

15424 (DNPL/NSF/R-1, pp 27-37) POLARIZED SOURCES. THE PRESENT POSITION. England, J. B. A. (Univ. of Birmingham, Eng.). 1972.

From Symposium on polarized beams; Daresbury, England (10 Jan 1972).

A summary is presented of 27 polarized hydrogen isotope ion sources (19 atomic beam sources, 8 Lamb-shift sources) in existence in January 1972. Data such as ion type, beam current, and polarization are given for most of the sources, and additional design information or other comments in a few cases. (UK)

15425 (INIS-J-139) STUDIES OF BEAM EXTRACTION SYSTEM OF THE 107 CM MODEL MAGNET FOR THE 176 CM SF CYCLOTRON. Tanabe, T.; Ogawa, H.; Sekiguchi, M.; Sakurada, Y.; Furuya, M.; Yamazaki, T.; Yamada, T.; Fujita, M.; Honma, T.; Hirao, Y. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 27 Nov 1972. 34p. Dep. NTIS (U. S. Sales Only).

Beam extraction calculations using the field data of the 107-cm model magnet corrected by trimming coils are discussed. The purpose of these calculations is to fix the position of the deflector system relative to the spiral shims and to decide the approximate shape of the deflectors. The radial position of the deflector entrance, azimuthal position of the deflector entrance, resonant extraction, and the particle orbit in the deflector channel are discussed. (WHC)

15426 TUBE WITH A NEEDLE FIELD-EMISSION CATHODE FOR OBTAINING NANOSECOND PULSES OF FAST ELECTRONS. Pavlovskaya, N. G.; Kudryavtseva, T. V. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 540-543(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 188-201(1972).

A sealed two-electrode electron tube with a field-emission needle cathode is described. For an accelerating-voltage amplitude of 150 kV with a leading-edge slope $\sim 10^{14}$ V · sec^{-1} a flux of $\sim 10^{13}$ electrons per pulse having a duration of several nanoseconds is created on the outside surface of the beryllium window of the tube. For operation in a one-shot mode for a period of a year the tube withstood more than 10^5 switchings without a noticeable change in its characteristics. The dose near the output window is ~40 krads per pulse ($\sim 8 \times 10^{12}$ rads · sec^{-1}). (3 figures) (auth)

15427 NEGATIVE-ION SOURCE. Ayukhanov, A. Kh.; Chernenko, V. N. (Inst. of Electronics, Tashkent). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 480-481(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 150-151(1972).

A source of negative ions is described which uses the emission of negative ions as a result of bombardment of certain solid surfaces by positive alkali ions. Using the source in combination with a mass analyzer, stable beams of negative Cu, Ag, Au, C, O, Cl, and certain hydrocarbons were obtained having intensities of 10^{-9} to 10^{-7} A. (1 figure) (auth)

15428 USE OF A SPIKE CATHODE WITH A DUOPLASMATRON ION SOURCE. Champan, K. R.; Rowton, L.; Trimble, S. (Florida State Univ., Tallahassee). Nucl. Instrum. Methods; 106: No. 2, 253-257(1973).

With the use of a plasma-expansion cone to obtain increased output, higher arc currents were necessary to obtain the full advantage of the expansion cone. These increased currents reduce filament life considerably and would require a heavier gauge filament wire, with higher heat dissipation in the source head, to give an acceptable life. An alternative cathode consisting of a tungsten spike was constructed and has proved very satisfactory. Measurements have been made of the arc current and extracted ion beam to determine the modulation both with a tungsten hair pin filament and with the spike cathode. It is shown that providing the arc current is sufficiently high there is no significant difference in high frequency modulation. While unless the filament is heated by dc a significant 60 cycle modulation occurs when the hair pin filament is used. (auth)

15429 PRODUCTION OF A BEAM OF POLARIZED NEGATIVE DEUTERIUM IONS. Khirnyi, Yu. M.; Kochemasova, L. N. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 640-43 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 25-28(1972).

A source of polarized negative deuterium ions is described which uses Lamb shifts of the levels and static magnetic fields. The current of D_1^- ions amounts to 0.012 μA and $P_{33} = -(0.718 \pm 0.010)$. (auth)

Ion Optics and Field Calculations

15430 (BARC/I-155) ENVELOPE: A COMPUTER CODE FOR CHARGED PARTICLE DYNAMICS IN BEAM TRANSPORT SYSTEMS. Jain, A. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 11p. INIS.

Program ENVELOPE was written in Fortran IV for the CDC 3600 computer. The program contains subroutines for the motion of an ion in a drift space, quadrupole magnet lens system, double focusing analyzing magnet system, slit, etc. If the sequence and parameters of the beam transport elements in the system are specified in the data, the subroutines are called in the same sequence. The beam envelope is traced in a desired number of steps using the appropriate transfer matrix of the beam transport element and treating the length along the optic axis in this matrix as a variable. The final beam parameters due to one subroutine are automatically fed as the initial beam parameters in the succeeding subroutine. This makes any general arrangement of elements possible in the system. Several systems can be studied in a single run. (auth)

15431 (BARC/I-156) REPORT ON QUADRUPOLE MAGNET IN VEC BEAM TRANSPORT SYSTEM, THEORETICAL DESIGN CONSIDERATIONS. Sethi, R. C.; Divatia, A. S. (Bhabha Atomic Research Centre, Bombay (India)). 1971. 41p. INIS.

The focusing properties of the quadrupole singlet and quadrupole doublet under thin and thick lens approximations are derived using the matrix method. Different types of matching devices used in the beam transport system for matching the beam with the optical system are explained. The major aberrations, spherical and chromatic, which appear in quadrupole magnets, are calculated. Specific applications to the VEC Beam Transport System are given. (auth)

15432 (BNL-17539) EFFECT OF A NONUNIFORM INCOHERENT ν SHIFT ON THE STABILITY CRITERION FOR TRANSVERSE COLLECTIVE OSCILLATIONS. Month, M. (Brookhaven National Lab., Upton, N. Y.). 3 Jan 1973. 17p. Dep. NTIS.

A review is given of the two sufficient stability criteria against growing transverse dipole oscillations self-induced in a particle beam. The effect of a nonuniform incoherent ν shift is then considered. The first stability criterion places a lower limit on the width, δ, of the ν distribution, and can be written $\delta > \delta_0$, where δ_0 depends on the chamber and beam geometry, as well as on the chamber conductivity. It is shown that a skewing of the density distribution, by a nonuniform ν shift of maximum value s_ν at the beam center, changes this condition to $\delta > \max(\delta_0, s_\nu)$. The second stability criterion can be stated as an upper limit on the ν density, N, i.e., $N\,\nu\,n_0$, where n_0 has a functional dependence qualitatively similar to δ_0, but depends more strongly on chamber conductivity. A skewing of the ν distribution affects this stability criterion only insofar as it affects the peak value of the density. This depends on the initial distribution of ν values, unaffected by the ν shift. If it is peaked and one-humped, the effect will be minimal; while if it is uniform, the increase in maximum density could be large. To compensate, an increase in the ν spread in the beam is required. This procedure will be successful to the extent that it decreases the density maximum. Some comments concerning the CERN experience are made. (auth)

15433 (CONF-700929-(Vol.1), pp 343-51) BAND CLOSING IN AN ALVAREZ TYPE PERIODIC STRUCTURE. Jule, Willard (Univ. of Massachusetts, Amherst); Gluckstern, R. L.; Chasman, Renate. 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Dispersion curves for azimuthally symmetric TM modes in an Alvarez type structure are studied. The method of Walkinshaw et al., as formulated in the 1969 IEEE paper of Gluckstern et al., has been reformulated for arbitrary phase advance per cell in a periodic stemless drift tube structure. In the present formulation, the dispersion curve is obtained from a two by two transcendental determinant, permitting simpler and more accurate computation than with the 2N by 2N determinant for an arbitrary N cell drift tube structure in the previous work. The new formulation has been used to study hand closing by varying the drift tube radius to achieve tuning of the equivalent coupling cell. In this way, two bands have been made to cross at the π-mode with non-zero slope. The behavior of the dispersion curves for the undercoupled and overcoupled cases is also shown. Information is also obtained about higher bands. The relations of these results to those obtained with coupled circuit chains are discussed. (auth)

15434 (CONF-700929-(Vol.1), pp 353-8) NOTE ON NUMERICAL CALCULATIONS OF LINEAR ACCELERATOR CAVITIES. Kulinski, Stanislaw (Inst. of Nuclear Research, Swierk, Poland). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Recently M. Martini and D. J. Warner (Numerical Calculations for Linear Accelerator Cavities, CERN Report 68-11) have proposed a new method of calculation of linear accelerator cavities. This method is a compound of an analytical solution and of a classical over-relaxation and allows for considerable saving of computation time. It is obtained by limiting the time consuming over-relaxation technique to a relatively small axial region of a cavity. In the upper region sufficiently far from drift-tubes an analytical solution can be properly fitted to that of the lower region used. The present paper is a continuation of the mentioned paper of M. Martini and D. J. Warner in the direction of further limitation of unnecessary numerical calculations in the region where analytical expressions for field can be used. In this way further reduction of computation time as well as of the computers memory can be achieved. (auth)

15435 (CONF-700929-(Vol.2), pp 733-58) BEAM DYNAMICS IN A HELIX LINEAR ACCELERATOR FOR HEAVY IONS. Klabunde, J.; Deitinghoff, H.; Junior, H. P.; Klein, H. (Univ., Frankfurt am Main). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The uncoupled equations of motion, corresponding to the synchronous particle, are used for the choice of the focusing device and the determination of quadrupole field gradients, giving maximum radial acceptances. The transverse and axial acceptances are then computed by using the general expressions for particle motion. Effects of coupling and nonlinearities are considered. Energy spread and phase width of the particle bunches are calculated for different final energies of ions. The problem of energy variation, the simultaneous acceleration of differently charged ions, the maintenance of good time structure of the beam within a wide energy range and the possibility of increasing the final energy for ions with higher charge-to-mass ratio are presented. (auth)

15436 (CONF-700929-(Vol.2), pp 759-70) CONSIDERATIONS OF FOCUSING A SUPERCONDUCTING HELIX-PROTON-LINEAR ACCELERATOR BY ALTERNATING THE SYNCHRONOUS PHASE. Junior, H. P.; Klabunde, J.; Deitinghoff, H.; Klein, H. (Univ., Frankfurt am Main). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The high acceleration rate achievable in a superconducting helix linac as discussed recently suggests a reappraisal of the focusing method, where adjacent helix sections are tuned such that the synchronous phase changes periodically. This method proves rather weak in a conventional linac with 1 MeV/m. Nevertheless at acceleration rates as high as 3 to 4 MeV/m axial and radial acceptances of particles turn out to be comparable to those of a machine focused strongly by quadrupole-doublets. Computations at proper helix parameters are discussed for a proton structure similiar to the 0.75 to 20 MeV machine, which is part of the prototype of a superconducting linac designed at the Kernforschungszentrum Karlsruhe. (auth)

15437 (CONF-700929-(Vol.2), pp 771-90) NUMERICAL METHODS FOR SOLVING ABERRATION AND SPACE CHARGE PROBLEMS IN BEAM TRANSPORT SYSTEMS. Tanguy, P. (Faculte des Sciences, Rennes, France). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Numerical methods have been set up to follow the beam behavior in an arbitrary transport system taking into account all nonlinear forces experienced by the particles in the beam. Various distributions in the four dimensional phase space have been considered under the assumption of an essentially non-laminar flow. An application has been made to the present preinjector of the CERN synchrotron; the results obtained are consistent with experimental evidence. (auth)

15438 (CONF-700929-(Vol.2), pp 791-809) INVESTIGATION OF THE NONLINEAR DYNAMICS OF A PROTON BEAM USING THE HYDRODYNAMIC METHOD. Davies, A. J. (CERN, Geneva, Univ. of Swansea, Wales). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A study has been made of the dynamics of the proton beam in the pre-injector region of the CERN Linac where the beam has approximate rotational symmetry. It is shown that the hydrodynamic approach (allowing for particle overtaking and the nonlinear effects of space charge) can give a satisfactory description of the beam dynamics. The numerical program has been designed to operate in a semi-interactive manner, via a remote cathode ray display, with a CDC 6600 computer and has proved a powerful tool in investigating the properties of the proton beam. Typical results are presented and discussed. (auth)

15439 (CONF-700929-(Vol.2), pp 811-21) OSCILLATION MODES IN TWO DIMENSIONAL BEAMS. Gluckstern, R. L. (Univ. of Massachusetts, Amherst). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The modes of oscillation of a uniform one-dimensional beam have been derived and studied by Sacherer and Smith. The present work is an extension of their work to two dimensions, using a matched Kapchinsky Vladimirsky beam as the unperturbed configuration. The method consists of obtaining two coupled integral equations in the perturbed phase space distribution and in the electric field. Solutions of these equations for different modes of oscillation are obtained, and the frequency spectrum of these modes is presented as a function of space charge intensity. It is shown that these modes correspond to surface distortions of the KV ellipsoidal surface in 4-dimensional phase space. The bearing of these results on space charge limits in linear and circular accelerators is discussed. (auth)

15440 (CONF-700929-(Vol.2), pp 823-48) STABILITY OF PHASE SPACE DISTRIBUTIONS IN TWO DIMENSIONAL BEAMS. Gluckstern, R. L. (Univ. of Massachusetts, Amherst); Chasman, Renate; Crandall, Kenneth. 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

The most convenient method for including space charge forces in beam dynamics calculations is that proposed by Kapchinsky and Vladimirsky. This distribution corresponds to an ellipsoidal shell in 4-dimensional phase space, leading to uniform distributions in all two dimensional projections, and to linear space charge forces. Beam emittance measurements are for the most part not completely consistent with the KV distribution. Phase space and real space projections indicate instead a central core of high density surrounded by a tail or halo of lower density. The present work is an effort to determine whether or not the matched KV distribution is stable. Numerical orbit calculations for an azimuthally symmetric unaccelerated KV beam have been performed with a constant externally applied radial restoring force in an effort to see whether the distribution in the total energy of each particle remains unchanged. In addition, a family of other stationary 4-dimensional phase space distributions is studied analytically and computationally. The total beam energy for fixed intensity and rms emittance is explored in an effort to determine which distribution is most stable. (auth)

15441 (CONF-700929-(Vol.2), pp 851-66) LINAC QUADRUPOLE GRADIENTS AND MATCHING PARAMETERS AT DIFFERENT BEAM INTENSITIES. Bru, B. (Institut de Physique Nucleaire, Lyon); Weiss, M. 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

With higher beam intensities the required strength of linac quadrupoles as well as the parameters of the matched beam differ more and more from the zero space charge values. A simple method of calculation is presented by which the quadrupole gradients, matching parameters and linac acceptances for any beam current can be obtained. The beam is considered as a uniformly charged ellipsoid and the whole treatment is linear. A computer programme has been developed to determine the parameters. It traces, in addition, the beam through the computed structure and displays its envelope on a graphical output. In this way it is possible to see how well the beam is matched. The results obtained for ++-- and +- structures are presented. (auth)

15442 (CONF-700929-(Vol.2), pp 881-98) PROBLEMS OF PARTICLE TRANSMISSION IN A HIGH-INTENSITY PROTON ACCELERATOR COMPLEX. Taylor, C. S. (CERN, Geneva). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Some of the general problems of high-intensity proton accelerators, i.e., the efficiency of the accelerator for the transmission of particles, and the allied questions of the optimization of the many variables which can affect the intensity, and the statistical behavior of the machine are discussed. Some comments are made on operational aspects of high intensity machines, and on the feasibility of approaching phase space density conservation in proton accelerators. (auth)

15443 (CONF-700929-(Vol.2), pp 899-904) PHASE SPACE ACCEPTANCE OF A GENERAL TRIPLET. Regenstreif, E. (Faculte des Sciences, Rennes, France). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

Explicit formulae are given for the phase space acceptance of a general (not necessarily symmetric) quadrupole triplet. Nine different phase space configurations are possible in the focusing-defocusing-focusing plane and four in the defocusing-focusing-defocusing plane. (auth)

15444 (CONF-700929-(Vol.2), pp 1151-5) BEAD PERTURBATION MEASUREMENT. Trump, M. A.; Machen, D. R.; Paciotti, M. A.; Schneider, E. J.; Swenson, D. A. (Los Alamos Scientific Lab., N. Mex.). 1970.

From Proton linear accelerator conference; Batavia, Ill. (28 Sep 1970).

A common method of determining the fields in a linear accelerator tank is to measure the change in the tank resonant frequency when a small metallic bead is pulled through the accelerating gaps along the tank axis. A system for detecting and measuring these small frequency changes is described. The period of each cycle of a low beat frequency signal is accurately determined by means of a zero crossing detector and a digital timer. Data are collected and processed by a small digital computer and the results are displayed at the end of each run. (auth)

15445 (LBL-1224) ALIGNMENT OF DRIFT TUBE QUADRUPOLE LENSES USING A PULSED WIRE. Main, R. M. (California Univ., Berkeley. Lawrence Berkeley Lab.). Sep 1972. Contract W-7405-eng-48. 6p. (CONF-720908-23). Dep. NTIS.

From fourth international conference on magnet technology; Upton, NY (19 Sep 1972).

The Berkeley HILAC drift tube quadrupole magnet system has been aligned using a taut wire suspended along the accelerator axis. With a single magnet excited, the direction of movement of the wire, when carrying a pulse of current, indicates the position of one of the transverse magnetic planes with respect to the wire. Both planes can be aligned independently by reversing the direction of the current pulse in the wire. The wire is vertically adjusted at its two ends to compensate for the calculated sag at each drift tube position. The adjustment of the mean (with regard to magnet imperfections and longitudinal skew) longitudinal axis of the quadrupole to the axis defined by the wire is extremely rapid, requiring about five minutes per drift tube, and deviations as small as 0.02 mm can easily be detected. The precision of alignment of the HILAC system, limited by relatively coarse hanger adjustments and by thermal motion of the support system during alignment, is estimated to be $\Delta R \leq 0.1$ mm. (auth)

15446 METHOD FOR FINDING THE MAGNETIC CENTRE OF A QUADRUPOLE FIELD. Cobb, R. W.; Hodges, T. A.; Kirk, A. D.; Pearce, R. M.; Robertson, L. P. (Univ. of Victoria, British Columbia). Nucl. Instrum. Methods; 106: No. 2, 259-262 (1973).

A non-paramagnetic body floating with neutral buoyancy in a paramagnetic fluid takes up a position of minimum energy in a magnetic field. This forms the basis of a convenient and accurate device to locate the center of a quadrupole field. (auth)

15447 SIMULATION OF HEAVY ION SCATTERING AT STRIPPERS IN BEAM OPTICS CALCULATIONS FOR TANDEM VAN DE GRAAFF ACCELERATORS. Joy, T. (Daresbury Nuclear Physics Lab., Warrington, Eng.). Nucl. Instrum. Methods; 106: No. 2, 237-240(1973).

A procedure is worked out which enables the scattering of heavy ions at strippers to be explicitly incorporated into beam optics calculations for tandem Van de Graaff accelerators. The method is applicable to the phase space ellipsoid type of calculation or ray tracing. An example is given of the use of the procedure with an interative beam optics computer program. (auth)

15448 MEASUREMENTS AND SECOND-ORDER CALCULATIONS OF THE EINDHOVEN BEAM TRANSPORT SYSTEM. Sandvik, G. E.; Hagedoorn, H. L.; Schutte, F. (Eindhoven Univ. of Tech., Netherlands). Nucl. Instrum. Methods; 106: No. 2, 245-252(1973).

The horizontal and vertical emittances of the extracted beam from the Eindhoven A.V.F. cyclotron have been measured for different particle energies and yields <25 mm mrad. These areas have been used for linear calculations of beam properties through the beam transport system in doubly achromatic and dispersive modes of operation. The results are compared with measurements. For the 45° bending magnets non-linear effects have been extracted from orbit integrations and comparison is made with the theoretical estimations of the second-order coefficients. These increase the $\Delta E/E$ value calculated by the linear approximation by 0.02%. This implies that with entrance and exit slit widths of 0.5 mm an analysed beam of 2 μA pit pf 100 μA with an energy spread of 0.05% fwhm is obtainable. (auth)

15449 SEPARATRIX OF COHERENT PHASE OSCILLATIONS IN AN ACCELERATOR WITH ALLOWANCE FOR THE VOLTAGE INDUCED BY THE BEAM. Heifets, S. A. (Erevan Physics Inst.). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 319-322(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 20-23(1972).

Expressions are derived for the effective potential energy, its extremal points, and the separatrix of coherent phase oscillations. A study is made of the necessary condition for stability of coherent phase oscillations for a high particle current and a large detuning of the accelerating cavity resonators. The optimal parameters of the accelerating system are found which ensure the minimum power of the external oscillator for a stipulated particle current and a required particle-energy scatter. (2 figures) (auth)

15450 COMPENSATION OF THE AMPLITUDE NONUNIFORMITY OF THE MAGNETIC FIELD OF A BETATRON. Aleksandrovskii, M. R. Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 631-633(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 18-20(1972).

Methods are indicated for compensating the amplitude nonuniformity of the magnetic field of a betatron. The distortion of the equilibrium orbit is affected to the greatest extent by the first harmonic of the expansion of the amplitude nonuniformity, while the sine component predominates in this harmonic by virtue of a number of technological factors. The lowering of this component is achieved by skewing the magnetic core. An equalizing skew considerably increases the radiation intensity. (auth)

Storage Rings

Refer also to abstracts 14704, 14932, and 15432.

15451 (BNL-17462) RADIATION FROM 200-GeV PROTONS AND ITS POSSIBLE USEFULNESS. Blewett, J. P. (Brookhaven National Lab., Upton, N. Y.). 12 Dec 1972. 2p. Dep. NTIS.

The properties of synchrotron radiation from 200-GeV protons are reviewed. Their possible use in ISA diagnostics is suggested. (auth)

15452 (BNL-17472) NEW METHOD FOR INJECTION INTO THE ISA. Blewett, J. P.; Cottingham, J. G. (Brookhaven National Lab., Upton, N. Y.). 12 Dec 1972. 8p. Dep. NTIS.

A new method is proposed for injection into ISABELLE. The method involves successive extraction of single bunches from the AGS and compaction of the bunch sequence in the ISA. Very low final energy spread ($\pm 0.7 \times 10^{-4}$) is achieved at 200 GeV in the ISA. (auth)

15453 (BNL—17508) INJECTION INTO ISABELLE AFTER ACCELERATION ON THE FUNDAMENTAL FREQUENCY IN THE AGS. Chasman, R. (Brookhaven National Lab., Upton, N. Y.). 19 Dec 1972. 10p. Dep. NTIS.

Acceleration on the fundamental frequency in the AGS is suggested in order to form a single bunch in that machine. The bunch can be further compressed after acceleration by the use of the existing twelfth harmonic rf system. The procedure allows for azimuthal stacking of 90 AGS pulses in ISABELLE. (auth)

15454 (CEAL-3063-3) LATEST DEVELOPMENTS WITH COLLIDING BEAMS IN THE CEA. Averill, R.; Hofmann, A.; Little, R.; Mieras, H.; Paterson, J. M.; Strauch, K.; Voss, G.-A.; Winick, H. (Cambridge Electron Accelerator, Mass.). Oct 1972. Contract AT(11-1)-3063. 15p. (CONF-721029-4). Dep. NTIS.

From 3rd all-union conference on high-energy particle accelerators; Moscow, USSR (2 Oct 1972).

The operation and performance of the CEA colliding beam facility (bypass) is briefly described. (WHK)

15455 (CERN-72-21, pp 423-441) ACCELERATOR CONTROL. Keyser, R. (CERN, Geneva). 1 Dec 1972.

The role of a small computer system in the control of the intersecting Storage Rings (ISR) is considered from software and hardware points of view. The aims of the system and the tasks which it carries out are described; the latter include monitoring, operation programs (setting of magnet power supplies, beam observation, and vacuum system supervision), and development. Man–machine communication and the application of CAMAC to the ISR control computer are discussed. Finally, the organization of the computer to carry out the necessary tasks is examined; hardware interrupts, software interrupts, program activator, and core store allocation are included. (4 figures) (RWR)

15456 (LNF-72/75) LUMINOSITY MEASUREMENTS AT ADONE USING SINGLE AND DOUBLE BREMSSTRAHLUNG. Dehne, H. C.; Preger, M.; Tazzari, S.; Vignola, G. (Comitato Nazionale Per L'Energia Nucleare, Frascati (Italy). Laboratori

Nazionali Di Frascati). 21 Sep 1972. 30p. Dep. NTIS (U.S. Sales Only).

The latest set of luminosity measurements carried out at Adone last March is reported. Single (SB) and double (DB) bremsstrahlung reactions were measured at several energies and compared with the results obtained at the same time by the "$\mu-\pi$" group, measuring small-angle-Bhabha-scattering. The three luminosity measurements were found to be in agreement within the expected systematic errors. (auth)

15457 (SLAC-Trans-149) EFFECT OF NONLINEARITIES ON BETATRON OSCILLATIONS IN A STORAGE RING. Kulipanov, G. N.; Mishnev, S. I.; Popov, S. G.; Tumaikin, G. M. Translation of a Russian preprint. 30p. Dep. NTIS.

An experimental study has been carried out on the main parameters of regions of phase stability of transverse betatron oscillations of linear resonance and nonlinear resonance $4\nu_z = 3$, obtaining a good agreement with theoretical expectations. The influence of various effects on particle lifetime in the phase-stability regions has been studied. Results are given on particle capture in the phase stability region. The influence of synchrotron oscillations and resonance perturbations on the behavior of particles in the phase-stability region was investigated. (auth)

15458 APPLICATION OF CRYOPUMPING TO COLLIDING BEAM PHYSICS EXPERIMENTS. Benvenuti, C.; Calder, R. S. (European Organization for Nuclear Research, Geneva). Vide; No. 157, Suppl., 29-37(1972).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

The cryopumps associated with the ISR at CERN are described in detail. An ultra-high vacuum of about 10^{-12} torr is obtained. (France)

15459 DESORPTION DUE TO SYNCHROTRON RADIATION IN ELECTRON AND POSITRON STORAGE RINGS. Liot, R. (Ecole Normale Superieure, Orsay, France). Vide; No. 157, Suppl., 215-20(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

The power radiated in the form of synchrotron radiation and the characteristics of the radiation incident on the walls are studied. The degassing rate at ambient temperature is evaluated together with the static pressure. The dynamic pressure in the presence of the DCI beam was calculated by extrapolating the values observed for the Orsay storage ring and then evaluating the photon-photoelectron and photoelectron-released molecule yields. (France)

15460 STUDY OF THE DEGASSING SPECTRA OF MATERIALS USED IN THE CONSTRUCTION OF THE VACUUM CHAMBER OF A 1.8 GeV e^+e^- STORAGE RING. Souchet, R. (Ecole Normale Superieure, Orsay, France). Vide; No. 157, Suppl., 221-31(1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

The desorption phenomena exhibited by the principal materials used in the construction of the ultrahigh vacuum enclosures of the DCI storage ring were studied. These materials include ferrites, aluminum, and stainless steel. It is suggested that appropriate treatment of these materials would improve the pumping to a greater extent than an increase in the pumping speed. (France)

Experimental Facilities

Refer also to abstracts 14704, 14851, 14852, 14902, 14908, 14909, 14932, 14933, 16033, 16049, 16067, and 16224.

15461 (CERN-72-21, pp 365-384) BIRTH AND LIFE OF THE BOL-SYSTEM. Oberski, J. E. J. (Inst. for Nuclear Physics Research, Amsterdam). 1 Dec 1972.

After a brief description of the Institute for nuclear physics research (Amsterdam), the BOL-system for measuring coincidences between charged particles from nuclear reactions initiated by synchrocyclotron beams is discussed. Particle type, energy, and angle are recorded for every particle of a coincident event. Events are stored on magnetic tape for subsequent off-line analysis. The scattering chamber, detectors, measuring electronics, and computers are described. The historical background and the use of the BOL-system in experiments are reviewed. Conclusions reached as a result of experience with the BOL-system are summarized. (6 figures, 19 references) (RWR)

15462 (DNPL/NSF/R-1) SYMPOSIUM ON POLARIZED BEAMS HELD AT DARESBURY LABORATORY, 10 JANUARY 1972. England, J. B. A. (ed.) (Daresbury Nuclear Physics Lab. (England)). 1972. 66p. (CONF-720125). Dep. NTIS (U. S. Sales Only).

Six papers were presented at the conference; a separate abstract was prepared for each. (UK)

For abstracts of individual papers see: 15422–15424, 15463, 15464, and 16033.

15463 (DNPL/NSF/R-1, pp 39-47) POLARIZED BEAMS: WHAT USE ARE THEY? Griffith, J. A. R. (Univ. of Birmingham, Eng.). 1972.

From Symposium on polarized beams; Daresbury, England (10 Jan 1972).

The uses of polarized beam facilities are reviewed, and it is suggested that interest in nuclear spin-dependent forces for their own sake will be followed by developments throughout nuclear structure physics in which spin-dependent effects will be useful tools. Examples are given of uses in nuclear spectroscopy and nuclear reaction mechanisms, and studies of polarization in the region of analog resonances; and others are suggested. (UK)

15464 (DNPL/NSF/R-1, pp 49-55) NUCLEAR STRUCTURE FACILITY AS A SOURCE OF POLARIZED NEUTRONS AND THEIR RELEVANCE AS NUCLEAR PROBES. McKee, J. S. C. (Univ. of Birmingham, Eng.). 1972.

From Symposium on polarized beams; Daresbury, England (10 Jan 1972).

It is stated that, as a result of recent research in the field of polarization transfer, the Nuclear Structure Facility at the Daresbury Laboratory could incorporate a highly polarized neutron beam of high intensity, of energy spread comparable to that for charged particle beams, and having continuously variable beam energy maintaining a high degree of polarization. The facility of flipping neutron spin at will by manipulation of rf transitions at the deuteron source could also be incorporated. The results of the recent researches into reactions involving light nuclei, in which the spin of an incident particle is transferred to an outgoing neutron, are reviewed briefly. (UK)

15465 (JINR-D1-6349, pp 615-23) PROGRAM OF PROTON-NUCLEAR SCATTERING EXPERIMENTS TO BE PERFORMED AT LAMPF. Palevsky, H.

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

A brief summary is given of proposed experiments at LAMPF, which involve protons and the use of the high resolution spectrometer. (LBS)

15466 (JINR-D1-6349, pp 641-50) HIGH ENERGY PHYSICS AND NUCLEAR STRUCTURE RESEARCH AT BERKELEY. Steiner, Herbert (Lawrence Berkeley Lab., Calif.).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

A brief review is given of the research program on high energy physics and nuclear structure centered around the Bevatron and the 184" synchrocyclotron. (LBS)

15467 (LA-DC-72-1470) LONG DISTANCE CAMAC BRANCH VIA DATA-LINK AND MICROPROGRAMMED BRANCH DRIVER. Biswell, L. R.; Machen, D. R.; Potter, J. M.; Rajala, R. E.; Thomas, R. F. (Los Alamos Scientific Lab., N. Mex.). 1972. 3p. (CONF-721202-5). Dep. NTIS.

From Nuclear science symposium and exhibits: nuclear instrumentation for research and development; Miami Beach, FL (6 Dec 1972).

An unusual solution to the problem of remote operation of CAMAC data systems, implemented at the Clinton P. Anderson Meson Physics Facility (LAMPF), is described. Data-link communications from a remote CAMAC system, controlled only by a Microprogrammed Branch Driver (MBD), to another CAMAC system coupled to a digital computer, can effectively extend the CAMAC branch highway to several hundred meters. A hybrid CAMAC system for remote data-acquisition and supervisory control in the beam line tune-up of the High Resolution Spectrometer (HRS) is described. (auth)

15468 (RHEL/R-257) π10 BEAM LINE FOR NUCLEAR STRUCTURE EXPERIMENTS ON NIMROD. Swales, F. J.; Reason, C. J. (Rutherford High Energy Lab., Chilton (England)). Sep 1972. 26p. Dep. NTIS (U. S. Sales Only). UK 30 pence.

The design methods for a pion beam-line suitable for nuclear structure studies in the range 200 MeV/c to 2000 MeV/c are presented. The particle rates on experimental targets are evaluated and details are given of the difficulties arising with extraction of low-energy negative beams from the Nimrod accelerator. (auth)

15469 TARGET FOR PRECISION MEASUREMENTS OF CROSS SECTIONS FOR THE INTERACTION OF PARTICLES WITH PROTONS AND DEUTERONS. Gorin, Yu. P.; Denisov, S. P.; Mitin, A. A.; Stoyanova, D. A.; Sytnik, V. V. (Inst. of High Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 330-332(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 29-31(1972).

The construction and characteristics of a target used to perform measurements of the total cross sections for the interaction of pions, kaons, and protons with protons and deuterons on the accelerator of the Institute of High Energy Physics are described. (1 figure) (auth)

15470 METHOD FOR THE MEASUREMENT OF THE CROSS-SECTIONS FOR THE PRODUCTION OF RADIOISOTOPES BY CHARGED PARTICLES FROM A CYCLOTRON. Watson, I. A.; Waters, S. L.; Bewley, D. K.; Silvester, D. J. (Hammersmith Hospital, London). Nucl. Instrum. Methods; 106: No. 2, 231-235 (1973).

A "spinning wheel" target system and calorimetric beam current integration system for the measurement of charged particle reaction cross-section is described. Results for two reactions determined by this method are compared with published data in order to assess the accuracy and reproducibility of the method. (auth)

15471 SCANNING X-RAY MICROSCOPE USING SYNCHROTRON RADIATION. Horowitz, Paul; Howell, J. A. (Harvard Univ., Cambridge, MA). Science; 178: No. 4061, 608-611(10 Nov 1972).

Focused synchrotron radiation from the Cambridge Electron Accelerator collimated by means of a pinhole has been used to construct a scanning x-ray microscope capable of making stereoscopic element-discriminating pictures of relatively thick specimens in an atmospheric environment. (auth)

15472 TELECONTROLLED EQUIPMENT WITH ACCURATE MULTI-DIRECTIONAL MOVEMENT OPERATING UNDER ULTRA-HIGH VACUUM. Thevenet, P.; Gillon, J. C.; Gogly, G. (CNRS, Saint-Maur-des-Fosses, France). Vide; No. 157, Suppl., 13-20 (1972). (In French).

From Vacuum technology meeting; Versailles, France (30 May 1972). See CONF-720572.

A telecontrolled device was developed for moving targets under ultrahigh vacuum in the 200-liter vessel of a particle accelerator. This device was subsequently adopted to control the movement of two carriages supporting probe devices in a 5.5-m^3 vacuum chamber designed to simulate an ionospheric plasma. The concepts behind the development of the equipment are presented, and the performance obtained is given. (France)

15473 SUPERCONDUCTING PARTICLE SEPARATORS. Lengeler, H. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 4: No. 3, 5-8(1972). (In German).

A contract has been signed between CERN in Geneva and the GfK with the aim to build a superconducting particle separator for CERN. The separator is at the moment being developed in IEKP and should be inserted in a test beam at CERN for the first time in 1974. It is being considered to develop this separator into an efficient system and in 1976 to include it in CERN II in counter experiments. (GF)

15474 OBTAINING A JET TARGET IN A VACUUM FROM CONDENSED HYDROGEN. Bargenev, V. D.; Valevich, A. I.; Pilipenko, Yu. K.; Smelyanskii, V. V. (Joint Inst. of Nuclear Research, Dubna, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 644-48(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 28-31(1972).

An experimental unit is described by means of which a hydrogen jet 8 to 13 mm in diameter having a density ~10^{-6} g/cm^3 was obtained in a vacuum. The jet could be readily observed visually and was recorded by filming. The system is being developed for use on the internal beam of an accelerator. (auth)

15475 FABRICATION OF LIQUID-HYDROGEN TARGETS FROM A LAVSAN (DACRON) FILM. Vasil'ev, L. M.; Dmitrevskii, Yu. P.; Mel'nik, Yu. M. (Inst. of High-Energy Physics, Serpukhov, USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 649-650(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 32-33(1972).

The technology of fabricating liquid-hydrogen targets 80 to 100 mm in diameter and up to one meter long from a Dacron film is described. The targets were used in experiments with particle beams from the 70 GeV accelerator of the Institute of High-Energy Physics. Gluing is carried out with glue based on ÉD-5 epoxy resin. The rupture pressure of the targets in experiments at the temperature 77°K amounted to >4 atm. (auth)

15476 PECULIARITIES OF MEASURING THE TOTAL CROSS SECTIONS OF REACTIONS CAUSED BY THE ACTION OF ALPHA PARTICLES. Dubar, L. V.; Nemets, O. F.; Slyusarenko, L. I.; Tokarevskii, V. V. (Inst. of Nuclear Research, Kiev). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 654-57(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 36-39(1972).

A unit is described for the measurement of the total cross sections of reactions caused by the action of α particles. The background was measured simultaneously with the determination of the magnitude of the beam attenuation. The contributions made by the different background components to the total background are analyzed, as well as the methods for reducing each of the components and monitoring them continuously. A method for calibrating current integrators for measurement of the charge ratio is presented. (auth)

15477 INSTALLATION FOR STUDYING THE CORRELATION OF GAMMA QUANTA WITH CHARGED PARTICLES. El-Kamkhavi, A. A.; Gurevich, G. S.; Kostyuchenko, S. K.; Zazulin, V. S. (Scientific-Research Inst. of Nuclear Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 661-663(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 42-45(1972).

The cyclotron experimental installation and electronic equipment used to study the correlation of γ quanta with charged particles formed in nuclear reactions on light nuclei is described. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

15478 DENSITIES OF BARYONS AND NEUTRINOS IN THE UNIVERSE FROM AN ANALYSIS OF BIG-BANG NUCLEOSYNTHESIS. Reeves, H. (CEN de Saclay, Paris). Phys. Rev., D; 6: No. 12, 3363-3368(15 Dec 1972).

The contribution from the "big bang" to the observed "cosmic" abundances of D, ^{3}He, ^{4}He, and ^{7}Li can, in principle, be used to determine and, in practice, give limits to the baryonic number B and the electron leptonic L_e of the universe. Limits of $B < 3 \times 10^{-3}$ ($\rho_b < 2 \times 10^{-30}$ g cm^3) and $-0.3 < L_e < 5$ are presented. There is a weak indication that $\rho_b \simeq 10^{-30}$ g cm^{-3} and $L_e = -0.18$ corresponding to a preponderance of antineutrinos over neutrinos. (auth)

Cosmic Radiation

Refer also to abstracts 15547, 15652, 15817, 15960, 16063, and 16119.

15479 (AD-743925) BALLOON EXPOSURE OF 30 M SQUARED OF CORPUSCULAR PHOTOGRAPHIC MATERIALS IN SEARCH OF SUPER-HEAVY COSMIC RADIATION. Filz, R. C.; Enge, Wolfgang; Davis, Albert (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 6 Apr 1972. 16p. (AFCRL-PSRP-487; AFCRL-72-229). NTIS.

Thirty square meters of plastic and nuclear emulsions along with some Cherenkov sensitive material were exposed to cosmic radiation at 120,000 feet in May 1971. The balloon was launched from Holloman AFB, New Mexico. (GRA)

15480 (AD-745815) ENERGY DEPENDENCE OF THE ANISOTROPY FOR COSMIC RAY ELECTRONS. Fischbein, William (Grumman Aerospace Corp., Bethpage, N. Y. Research Dept.). Jul 1972. 23p. (RM-548). NTIS.

The existence of a spatial anisotropy for the electron component of cosmic rays is considered for the energy range of 100 to 1000 GeV. It is found that an anisotropy as large as 1 percent is likely to be seen at energies as low as 100 GeV. Expressions are derived for the energy dependence of the anisotropy based on a model in which local pulsars are the predominant electron sources. Supernova radio remnants are considered as possible additional sources. (auth)

15481 (AD-746734) ELECTROMAGNETIC RADIATION PRODUCED BY HIGH ENERGY COSMIC RAYS. Final Scientific Report, September 1, 1969-February 29, 1972. Fegan, D. J.; Porter, N. A. (University Coll., Dublin (Ireland). Dept. of Physics). 17 Apr 1972. 89p. (UCD-CR-3; AFOSR-TR-72-1354). NTIS.

A fast night-sky Cherenkov detector has been used in a search for gamma rays in the energy region 10^{12} to 10^{13} eV from nine pulsars. Observations were made at a site in Malta during the years 1969-1971. Optical Cherenkov studies associated with both high-frequency and low-frequency radio emission from air showers are described. Measurements were made at the zenith and at large zenith angles. A small air shower array was constructed to study the lateral distribution of the uhf radiation from showers. (auth)

15482 (AD-747372) EQUILIBRIUM ENERGY SPECTRUM FOR THE GALACTIC COSMIC ELECTRONS. Suh, P. K. (Grumman Aerospace Corp., Bethpage, N. Y. Research Dept.). Jul 1972. 41p. (RE-432-J). NTIS.

A perturbational analysis of the cosmic electron diffusion equation is developed. In the high-energy domain, cosmic electron diffusion parallel to the galactic disk slab appears not to affect significantly the determination of the equilibrium electron energy spectrum. Diffusion across the galactic disk slab in the high-energy domain is examined in detail. An active cosmic electron leakage at the disk-halo boundaries, coupled with diffusion across the disk slab, sensitively affects the cosmic electron spectral behavior up to a considerably, high-energy domain. In the high-energy domain, the closed-disk model appears to prevail. In the low-energy domain, the leakage time may become comparatively long, thus leading to the possible validity of a quasi-open-disk model. (auth)

15483 (N-72-19863) ELECTRON-PRODUCTION RATE OF SOLAR AND GALACTIC COSMIC RAYS IN THE LOWER IONOSPHERIC D REGION. Research and Development Report, August 1969-June 1970. Argo, P. E. (Naval Electronics Lab. Center, San Diego, Calif.). 11 Aug 1971. 30p. (NELC-TR-1783). NTIS.

The heavy-ion component of galactic cosmic rays is found to yield an electron-production rate approximately one-half the magnitude of the proton component. At high altitudes, variations in the cut-off energy level in the middle and high geomagnetic latitudes (physically caused by geomagnetic storms) have a large effect on the electron-production rate of galactic cosmic rays (especially in the transition region between cut-off and no effective cut-off (approximately 68°); in the 30-to-60-km altitude region, however, electron production is not significantly affected. Solar protons can cause an abnormally high electron-production rate (at high latitudes) to all depths of the ionosphere, indicating a large effect on vlf reflection during solar particle storms. (auth)

15484 (N-72-25722) SOLAR MODULATION OF GALACTIC COSMIC RAYS. 3. IMPLICATIONS OF THE COMPTON-GETTING COEFFICIENT. Fisk, L. A.; Forman, M. A.; Axford, W. I. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Apr 1972. 33p. (NASA-TM-X-65901; X-661-72-128). NTIS.

Spectra of modulated galactic cosmic-rays are expressed in terms of the Compton-Getting coefficient C. This parameter can reveal the energy range over which the force field approximation is valid, and the range where convection effects dominate those of diffusion. A value of C near zero over an extended low-energy range implies that the radial gradient at low energies cannot be large. This small gradient may imply that the diffusion coefficient increases beyond 1 AU less rapidly than proportionally to heliocentric radial distance, and/or there is essentially no scattering for a sizeable distance from the Sun to Earth. The behavior of C with rigidity (or energy) is discussed in terms of the omnidirectional distribution function f_0. Contours of constant f_0 in the heliocentric distance vs rigidity plane are useful for illustrating the mean rigidity loss experienced by cosmic rays in the interplanetary medium. (auth)

15485 COUPLING FUNCTION FOR THE VERTICAL MUON TELESCOPE AT 60-METERS-WATER-EQUIVALENT DEPTH. Ahluwalia, H. S. (Univ. of New Mexico, Albuquerque). J. Geophys. Res.; 78: No. 1, 288-291(1 Jan 1973).

The coupling function for an underground muon telescope gives the contribution to its counting rate of each increment of the cosmic-ray primary rigidity spectrum. The shape of the primary spectrum and the multiplicity of production of muons in the atmosphere and underground are incorporated. The coupling function, applicable to an underground telescope, is important in making predictions regarding the response of the telescope to a given variation in the primary spectrum expected from a given theoretical model of a modulation process. Conversely, given an observed time variation of intensity with an underground muon telescope, the estimate of the modulation of primary flux in different bands of the primary spectrum may be made, provided the coupling function for the underground telescope is known. The coupling function for the underground vertical muon telescope situated at 60 meters water equivalent below sea level is discussed. Modulation phenomena observed during the large Forbush decrease of July 13, 1961 and the mean solar diurnal variation for the period 1965-1969 are used. Data of several research groups are compared and used to conclude that the Ahluwalia-Ericksen coupling function appears to give the best estimate of the rigidity response characteristics of the vertical muon telescope at 60-mwe depth. (JCW)

15486 ENERGY-DEPENDENT TIME LAG IN THE LONG-TERM MODULATION OF COSMIC RAYS. Burger, J. J.; Swanenburg, B. N. (Kamerlingh Onnes Laboratorium, Leiden). J. Geophys. Res.; 78: No. 1, 292-305(1 Jan 1973).

The intensity variations in the cosmic-ray electron spectrum above 500 MeV observed outside the radiation belts from March 1968 to August 1971 are reported. The data show the existence of a large energy-dependent hysteresis in the long-term modulation and two different types of steplike changes in the modulation parameter at rigidities below those observed with neutron monitors. The data indicate further that changes in the rigidity dependence of the modulation parameter occur mainly at rigidities above roughly 2 GV. The assumption that time-lag phenomena in the solar modulation reflect the effective size of the solar cavity is questioned, and alternative explanations of the energy dependent time lags are qualitatively investigated. 22 references. (auth)

15487 COSMIC-RAY ELECTRONS OF E > 1 GeV: SOME NEW MEASUREMENTS AND INTERPRETATIONS. Webber, W. R.; Rockstroh, J. M. (Univ. of New Hampshire, Durham). J. Geophys. Res.; 78: No. 1, 1-11(1 Jan 1973).

New measurements of the primary electron spectrum from 1 to 20 GeV with an electron spectrometer telescope at Fort Churchill were conducted in the summer of 1971. This telescope has been calibrated by using electrons and pions of 0.5 to 15 GeV at SLAC (Stanford Linear Accelerator) in early 1971 and again in 1972. The differential primary electron spectrum over the energy range 3 to 20 GeV is given by $dj/dE = 100/E^{3\pm0.2}$ el/m^2 ster sec GeV, the integral spectrum by $J(E) = 50/E^{2\pm0.2}$. These intensities are considerably lower than many earlier measurements above ~5 GeV. It is observed that many showers have anomalous lateral distributions as determined in the telescope and must be rejected. This directly leads to the lower intensities. The calibration results suggest that these events are due to interactions of high-energy protons. The measured primary electron spectrum is uncomfortably close to that calculated for secondary electrons produced by the interaction of cosmic-ray nuclei with interstellar hydrogen in the galaxy, and therefore the question of the origin of the high-energy electrons is reopened. The problem of the age of cosmic-ray electrons must also be reexamined if the measured spectrum is found to extend to still higher energies. 20 references. (auth)

15488 METHOD OF COMPUTING THE CHARACTERISTICS OF THE ENERGY SPECTRUM OF ALBEDO ELECTRONS FROM THE DATA OF SHIELDED GAS-DISCHARGE COUNTERS. Skryabin, N. G.; Sokolov, V. D. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 162-166(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 188-192(1972).

A method is described for determining the energy spectrum of albedo electrons and used to determine this spectrum in the cutoff rigidity interval from cosmic-ray intensity measurements by shielded and unshielded counters on Cosmos 19. (auth)

15489 OFF-ECLIPTIC CONTROL OF COSMIC RAY MODULATION. Hedgecock, P. C.; Quenby, J. J.; Webb, S. (Imperial Coll. of Science and Tech., London). Nature (London) Phys. Sci.; 240: No. 104, 173-175(25 Dec 1972).

The suggestion is made that phenomena happening well away from the ecliptic plane may be important controlling factors in the modulation of cosmic rays received at the Earth. (auth)

15490 HELIOCENTRIC RADIAL GRADIENT IN COSMIC RAY DENSITY AND THE "SWINSON" SIDEREAL TIME VARIATION. Thomson, D. M. (Imperial Coll. of Science and Tech., London). Planet. Space Sci.; 21: No. 1, 133-143(Jan 1973).

The sidereal time variation reported by Swinson (J. Geophy. Res.; 74: 5591(1969)) depends on the existence of a heliocentric radial gradient of cosmic-ray density in the rigidity range $\lesssim$100 GV and appears because of the inclination of the axis of rotation of the Earth to the normal to the ecliptic plane. It is sensitive to the polarity of the interplanetary magnetic field. Meson detectors on the surface of the Earth near the equator and at shallow underground depths can be used to measure this effect. Results obtained at Makerere on the Earth's surface and at Kilembe (50 mwe) in Uganda, East Africa, are compared with data previously reported by Swinson from Chacaltaya (25 mwe) and Embudo (40 mwe). From the relationship between the sidereal time variation and the heliocentric radial gradient it is concluded that the data are consistent with a local radial gradient of $((41 \pm 8)/P)\%$ AU^{-1} in the rigidity range $15 < P \lesssim 100$ GV during 1967 to 1971, a period including the most recent solar maximum. This estimate is consistent with modulation theory and the prevailing power spectrum in the interplanetary magnetic field. The Swinson effect is not appreciable at depths of more than 50 mwe underground. (auth)

15491 NEUTRON MONITOR MEASUREMENTS. Binder, O. Atomkernenergie; 20: No. 3, 225-226(Dec 1972). (In German).

Neutron monitor measurements have been started at Kiel in 1957. At first with the smaller IGY-type; since 1964 the observations were made with an 18 NM 64. The station is in contact with various others around the world. It exchanges data with 30 of them. The variations in the intensity of the neutrons in the range of 0.3 to 3 periods per hour are analyzed. In cooperation with Amsterdam and Bern an examination of the multiplicities of the neutrons takes place. In addition the long-period variations of amplitude and phase in the mean daily variation of neutron intensity are determined. (auth)

15492 STUDY WITH BALLOONS IN THE UPPER ATMOSPHERE. Roehrs, H. Atomkernenergie; 20: No. 3, 239-241 (Dec 1972). (In German).

A description of balloon launching equipment and the flights carried out in the northern part of Germany are given. The results of such balloon-flight measurements of the secondary photon spectrum in an energy range from 1.13 to 44 MeV at a residual atmosphere of 2.4 g/cm^2 are in good agreement with results of other authors, and also lower and high energies. Some notes are given for the measurement of primary photons. (tr-auth)

15493 CHEMICAL COMPOSITION OF COSMIC RAYS. Ptuskin, V. S. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 3, 318-23(1972).

Translated from Kosm. Issled.; 10: No. 3, 351-7(1972).

The propagation of heavy relativistic nuclei in the Galaxy is examined. A diffuse model with heterogeneous distributions of gas and of sources of relativistic particles is investigated. The problems of anisotropy and of the time of the cosmic rays' exit from the Galaxy are discussed. (auth)

15494 MODELLING NUCLEAR REACTIONS IN ISOTROPICALLY IRRADIATED THICK TARGETS. Lavrukhina, A. K.; Ustinova, G. K.; Malyshev, V. V.; Satarova, L. M. At. Energ. (USSR); 34: No. 1, 23-28(Jan 1973). (In Russian).

While revolving about two mutually perpendicular axes, an iron sphere, having a radius of 10 cm, was irradiated by a 660-MeV proton beam. As a result of such rotation, the surface of the sphere was irradiated isotropically. The activity of ^{24}Na in thin aluminum plates and ^{52}Mn, ^{48}V, ^{44m}Sc, ^{47}Sc, and ^{47}Ca in iron plates placed at various depths along the diameter of the sphere was measured. The experimental results are compared with calculated curves obtained by an analytical method used for the analysis of activity in meteorites and lunar rocks. It is shown that at a depth of ~2 cm below the surface the activity calculated by the analytical method closely agrees with the experimental results. The depth distributions of cosmogenic radionuclides in iron meteorites of various sizes are analyzed. A comparison with calculations by the Monte Carlo method is presented. (6 figures, 40 references) (auth)

Stars

Refer also to abstracts 15739, 15963, 15967, and 16096.

15495 (N-72-25831) EFFECT OF THE CORIOLIS FORCE ON THE STABILITY OF ROTATING MAGNETIC STARS. Sakurai, Kunitomo (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Mar 1972. 7p. (NASA-TM-X-65899; X-693-72-71). NTIS.

The effect of the Coriolis force on the stability of rotating magnetic stars in hydrostatic equilibrium was investigated by using the method of the energy principle. It is shown that this effect is to inhibit the onset of instability. (auth)

15496 SPECTRAL CLASSIFICATION OF SOUTHERN CARBON STARS. Rybski, P. M. Evanston, IL; Northwestern Univ. (1972). 168p. University Microfilms Order No. 72-32,557.

Thesis.

Well-widened objective prism spectra of carbon stars south of −25° declination were examined to determine their suitability for classification. The spectra, taken by Henize in the early 1950's from South Africa as part of the Michigan–Mt. Wilson Hα survey of the southern sky, had a reciprocal dispersion at Na I λ 5890 Å of 300 Å/mm and were in good focus in the range $\lambda\lambda$ 5100 to 6600 Å. Compared with spectra of northern carbon stars taken by the writer at the Lindheimer Astronomical Research Center with the one meter reflecting telescope and Cassegrain spectrograph at a grating reciprocal dispersion of 263 Å/mm, and compared with spectra taken recently by Henize of several of his southern carbon stars, the objective prism spectra were found of sufficient quality to support their classification into five groups following the scheme as proposed by Keenan and Morgan in 1941 and as refined by Gordon in 1967. While the principal thrust of this work was the classification of the southern carbon stars, a sufficient number of stars were found in each spectral grouping to allow associating tentatively those N and late R stars exhibiting evidence for an unusually low C^{12}/C^{13} ratio with those N and late R stars thought to possess a more common ratio. (Diss. Abstr. Int., B)

15497 INFLUENCE OF THE INTERSTELLAR MEDIUM PARAMETERS ON THE ACCRETION OF GAS BY A NEUTRON STAR. Amnuel, P. R.; Guseinov, O. Kh. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 1, 5-8(Jan 1971). (In Russian).

The amount of accretion of interstellar gas is determined by the mass of a neutron star, its temperature, density of the stellar gas, and the magnetic field which is "frozen in" in the interstellar gas. Unsymmetrical accretion by an isolated relativistic star is also hastened by gas ionization and a "frozen-in" magnetic field. Estimates are offered concerning the probable strength of the magnetic field, the energy loss by radiation, and gas temperatures. (KSW)

15498 SPECTROPHOTOMETRIC STUDY OF THE He II EMISSION LINE λ = 4686 OF THE WOLF–RAYET STAR HD 193793.

Babaev, M. B. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 1, 3-5(Jan 1971). (In Russian).

The star HD 193793 is a spectral double, magnitude 6.9m, period 7.9d. Ten spectrograms were obtained in 1968–1969, and the He II line at $\lambda = 4686$ indicated that a variability was evident in the course of a night, from night to night, and between the observations of 1968 and 1969. Changes in the central parts and in the wings occurred at about 10-minute intervals. (KSW)

15499 MASS OF THE ENVELOPE FORMED IN THE COLLAPSE OF A ROTATING STAR. Amnuel, P. R. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 8, 12-14(Aug 1971). (In Russian).

The mechanism and configuration of a rotating star at the moment of collapse is discussed, and equations are advanced which fix the mass of the stellar envelope in terms of the energy of the particles, the angular velocity of the star, distance of particles from the axis of rotation, the gravitational constant, and the densities at given radii. The need for other mechanisms of ejection are mentioned. (KSW)

15500 INFRARED CIRCULAR POLARIZATION OF NML CYGNI AND VY CANIS MAJORIS. Serkowski, K. (Univ. of Arizona, Tucson). Astrophys. J.; 179: No. 2, L101-L106(15 Jan 1973).

Circular polarization with a maximum of 0.6% at 1.7 μ was detected for the infrared source NML Cyg. Circular polarization of 0.1% at 2.2 μ and 0.2% at 1.7 μ was found for VY CMa. This indicates that the maximum circular polarization falls close to 1.0 μ at which wavelength Gehrels observed 0.4%. The linear polarization of several infrared sources and of the planet Mars was also observed. (auth)

15501 METAL ABUNDANCE OF RR LYRAE STARS IN THE GLOBULAR CLUSTER M22. Butler, D.; Kraft, R. P.; Miller, J. S.; Robinson, L. B. (Univ. of California, Santa Cruz). Astrophys. J.; 179: No. 2, L73-L78(15 Jan 1973).

The Preston system for measuring metal abundances of RR Lyrae stars was reestablished from equivalent-width measurements of Hγ, Hδ, and Ca II K in spectra obtained with the new image-tube scanner. The RR Lyraes of M22 were found to be metal poor. This conflicts with the expectation of metal richness as judged from the small slope of the giant branch in the H–R diagram. (auth)

15502 INFRARED OBSERVATIONS OF A HIGHLY REDDENED STAR NEAR NGC 6231. Knacke, R. F.; Strom, K. M.; Strom, S. E. (State Univ. of New York, Stony Brook). Astrophys. J.; 179: No. 2, 493-494(15 Jan 1973).

Infrared observations of NGC 6231-92 appeared to confirm Herbig's recent suggestion that this object is a highly reddened background star of type F5 Ia. (auth)

15503 STRUCTURE AND EVOLUTION OF PLANETARY NEBULAE. Capriotti, E. R. (Ohio State Univ., Columbus). Astrophys. J.; 179: No. 2, 495-516(15 Jan 1973).

The dynamical evolution of a model of an ideal planetary nebula is studied. In this picture, the H I shell, which surrounds an ionized sphere during the early stages in the evolution of a nebula, is accelerated outward by the thermal and dynamical pressure at its inner boundary or ionization front. The ionization front becomes dynamically unstable when the nebula has expanded and rarefied to the point where recombinations and ionizations become too slow to suppress positive and negative displacements, respectively, of the ionization front. In that case, the development of instability at the ionization front is similar to the development of the Rayleigh–Taylor instability at the interface of superposed, incompressible fluids of differing density. (WDM)

15504 CHARACTERISTICS OF THE ETA CARINAE COMPLEX. Walborn, N. R. (Univ. of Toronto). Astrophys. J.; 179: No. 2, 517-525(15 Jan 1973).

The nature and spatial relationship of Trumpler 14 and Trumpler 16 were clarified; Trumpler 14 was shown to be a more distant, exceedingly young cluster whose brightest member is a possible pre- or post-Wolf–Rayet star. The interpretation of the Wolf–Rayet stars in this region is discussed. Finally, a comment is made concerning the excitation of the H II region NGC 3372 associated with the two clusters. (auth)

15505 ULTRAVIOLET PHOTOMETRY FROM THE ORBITING ASTRONOMICAL OBSERVATORY. VII. α^2 CANUM VENATICORUM. Molnar, M. R. (Univ. of Colorado, Boulder). Astrophys. J.; 179: No. 2, 527-537(15 Jan 1973).

Far-ultraviolet photometry by OAO-2 is presented for α^2 CVn covering the entire 5.47^d period of this magnetic Ap variable. The light curves ranging from λ1330 to λ3320 indicate that there are two important sources of back warming from far-ultraviolet absorption. Strong line blanketing by the rare earths redistributes flux longward of the Balmer discontinuity, causing the major observed photometric variations. In addition, a second source, which may be due to a combination of continuous opacities and line blanketing from the iron-peak and rare earth groups below λ1600, apparently redistributes flux into the region of the Balmer discontinuity. It is also found that ground-based determinations of the effective temperature are overestimated due to the flux redistribution from far-ultraviolet absorption. The effective temperature of α^2 CVn derived from OAO and ground-based absolute fluxes is found to be 11,200°K, which remains constant over the cycle. (auth)

15506 SYNTHESIS OF CLOSE-BINARY LIGHT CURVES. V. THE CONTACT SYSTEMS W URSAE MAJORIS, AM LEONIS, V566 OPHIUCHI, AND GK CEPHEI. Hutchings, J. B.; Hill, G. (Dominion Astrophysical Observatory, Victoria, British Columbia). Astrophys. J.; 179: No. 2, 539-549(15 Jan 1973).

The programs described in earlier papers were adapted to apply to contact systems. In three of four systems investigated heating effects were found to be negligible, and convective gravity darkening to apply. In three systems the small star was the hotter and in all cases the dependence of opacity on local gravity was important. Best-fit models are presented and discussed for all four systems. (auth)

15507 RECENT PHOTOMETRIC VARIABILITY OF HD 184279. Dahn, C. C.; Guetter, H. H. (Naval Observatory, Flagstaff, AZ). Astrophys. J.; 179: No. 2, 551-554(15 Jan 1973).

Photometric observations made during the fall of 1971 indicated that HD 184279, a UBV standard and a known Be star, was then several tenths of a magnitude fainter than the standard values. Six-color and UBV observations are presented which show the wavelength dependence of this decrease in brightness (auth)

15508 STELLAR EVOLUTION AT HIGH MASS BASED ON THE LEDOUX CRITERION FOR CONVECTION. Stothers, R.; Chin, C. W. (Goddard Space Flight Center, New York). Astrophys. J.; 179: No. 2, 555-568(15 Jan 1973).

Theoretical evolutionary sequences of models for stars of 15 and 30 $M_\odot$ were computed from the zero-age main sequence to the end of core helium burning, with the use of the Ledoux criterion for convective instability. The sensitivity of the models to the most important physical input parameters was tested. During the earliest stages of core helium depletion, the envelope rapidly expands into the red-supergiant configuration because the hydrogen profile in the intermediate zone remains essentially unaltered by local convection. At 15 $M_\odot$, a blue loop on the H–R diagram ensues if the initial metals abundance, initial helium abundance, or $^{12}C + \alpha$ reaction rate is sufficiently large, or if the 3α reaction rate is sufficiently small. These quantities affect, respectively, the opacity (and hence depth) of the base of the outer convection zone, the mass of the core, and the thermal properties of the core. The blue loop occurs abruptly and fully developed when the "critical" value of any of these quantities is exceeded, and the effective temperature range and fraction of the lifetime of core helium burning during the slow phase of the blue loop vary surprisingly little. For the recently revised 3α reaction rate, the blue loop always forms. At 30 $M_\odot$, no blue loop occurs for any reasonable set of input parameters—unless the temporary convective intermediate zone (ignored in the present work) extends deeper than does the outer convection zone. For both masses, all passages of the Hertzsprung gap occur on the thermal timescale of the envelope. (auth)

15509 POST-EVENT NEUTRON EXPOSURE OF r-PROCESS MATERIAL. Blake, J. B. (Aerospace Corp., Los Angeles); Schramm, D. N. Astrophys. J.; 179: No. 2, 569-583(15 Jan 1973).

The effects of neutron fluxes on r-process material following the r-process event are considered. The calculations examine the case of neutron exposure occurring after the r-process material has decayed back to or near the valley of β-stability. Such exposure may occur during the r-process freeze-out or in some other subsequent neutron exposure. Limitations on these neutron fluxes are inferred from odd-even effects in the $A \sim 130$ and $A \sim 195$ r-process peaks and from the abundances of certain s-only nuclei. The effects of these neutron fluxes on the abundances of lead, bismuth, and the nucleochronologically important actinides are examined. (auth)

15510 ELECTRICAL AND THERMAL CONDUCTIVITIES OF A RELATIVISTIC DEGENERATE PLASMA. Kelly, D. C. (Goddard Space Flight Center, New York). Astrophys. J.; 179: No. 2, 599-606(15 Jan 1973).

The electrical and thermal conductivities are calculated for

an electron–proton plasma. The electron distribution function is obtained by solving the Boltzmann equation for a plasma in which the electrons are relativistic and degenerate while the protons are degenerate but nonrelativistic. Such conditions are expected to prevail in neutron-star interiors. The conductivities are increased by factors of order 10^6 over the values obtained when the protons are nondegenerate. The expression obtained for the electrical conductivity differs by a factor $^3/_4$ from the result of a variational calculation by Baym, Pethick, and Pines. (auth)

15511 GAMMA-RAY LINES FROM AN EXPANDING SUPERNOVA SHELL. Brown, R. T. (EG and G, Inc., Las Vegas, NV). Astrophys. J.; 179: No. 2, 607-613(15 Jan 1973).

Monte Carlo calculations were made of the transport of γ-ray lines out of the expanding shell of a Type I supernova produced by silicon burning. Because of the effect of Compton scattering the line spectrum of a young remnant is found to be superposed on a strong continuum, with no lines resolvable below 0.8 MeV. The predicted contribution to the diffuse γ-ray background from a large number of such sources emitting over a long period of time is shown to be a continuum with no measurable line profiles. (auth)

15512 HYDROGEN ATOM IN A STRONG MAGNETIC FIELD: BOUND–BOUND TRANSITIONS. Smith, E. R.; Henry, R. J. W.; Surmelian, G. L.; O'Connell, R. F. (Louisiana State Univ., Baton Rouge). Astrophys. J.; 179: No. 2, 659-663(15 Jan 1973).

Bound–bound transition probabilities were calculated for a hydrogen atom, in magnetic fields from 10^7 to 10^8 gauss. (auth)

15513 ENERGY GAP IN NEUTRON-STAR MATTER. Takatsuka, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1517-1533(Nov 1972).

On exactly taking into account the attractive effect of the $^3P_2$–$^3F_2$ coupling due to the two-nucleon tensor force and the effect of the one-body potential, the density region in the neutron-star matter where the $^3P_2$-superfluid state exists is determined as $\rho \simeq (2 \sim 8) \times 10^{14}$ g cm^{-3}. The tensor coupling effect is shown to play an indispensable role in the existence of the $^3P_2$-gap in neutron-star matter. The $^1S_0$-gap is also investigated, leading to the result that the $^1S_0$-superfluid state exists in the density region $\rho \simeq (1.0 \times 10^{11} \sim 1.5 \times 10^{14})$ g cm^{-3}. On the basis of these results, the region $\rho \simeq (1.5 \sim 2.0) \times 10^{14}$ g cm^{-3} is considered to result in the normal state. (auth)

15514 MASS LOSS BY SPORADIC EJECTION. Burke, J. A. (Univ. of Victoria, British Columbia). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 233-237(1972).

Mass loss by sporadic ejection of material can be effective in removing angular momentum from a star even in the absence of magnetic coupling. Under certain conditions a substantial transfer of angular momentum can occur with mass loss of only a few per cent. (auth)

15515 SPECTRAL LINE FORMATION IN EXTENDED STELLAR ATMOSPHERES. Grant, I. P.; Peraiah, A. (Oxford Univ.). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 239-247(1972).

A method of numerical solution of the equation of radiative transfer for spectral line formation in extended spherically symmetric stellar atmospheres is described. A simple non-LTE two-level atom model is assumed. Results are presented for the cases $b/a \leq 2$ where a is the inner and b the outer radius of the atmosphere. (auth)

15516 WHITE DWARF ENVELOPE STRUCTURE. Seidova, P. I.; Seidov, Z. F. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 9, 4-6(Sep 1971). (In Russian).

The structure of the outer layers of a white dwarf is discussed in terms of the density and the temperature, and how these parameters are related to the mass of the star and its luminosity: $L \sim T^4$. (KSW)

15517 ROTATION OF SUPERDENSE CONFIGURATIONS. Guseinov, O. Kh. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 9, 3(Sep 1971). (In Russian).

The author points out that his 1965 published work on the influence of rotation on the parameters of a neutron star was essentially confirmed by six subsequent papers by other workers (1967–1971) who failed to cite the prior publication. (KSW)

15518 PRELIMINARY RESULTS OF AN INVESTIGATION OF AO CAS SPECTRUM. Gasanalizade-Salmanova, L. Kh. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 7-9(Jun 1971). (In Russian).

The eclipsing variable AO Cas is a massive hot star of an early type, both components belonging to the spectra class O9III in the MK system. Spectra of the chief component were taken in the phase near the main eclipse. Equivalent widths were measured for all lines, and for strong lines of the Balmer series for hydrogen the central intensity and half-widths were also determined. Basic physical parameters of the atmosphere of the chief component are tabulated. (KSW)

15519 ORIGIN OF THE WOLF–RAYET STARS. Gusein-Zade, A. A. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 5, 6-8(May 1971). (In Russian).

The following scheme of evolution is proposed for Wolf-Rayet stars: W–R stars are formed from massive stars, W–R stars form a subordinate branch of O stars, and a portion of O stars in the spectral index interval 07 to 09 develop into W–R stars. (KSW)

15520 ROTATION OF STARS IN BINARY SYSTEMS. Piotrowski, S. L.; Rucinski, S. M. (Un v., Warsaw). Postepy Astron.; 20: No. 4, 351-355(Dec 1972). (In Polish).

Rediscussion of the paper by Nariai (Publ. Astr. Soc. Japan 23,529 (1972)) shows that the apparent dependence of the asynchronism parameter V/V_{syn} on orbital period for BOV-A3V binaries can be most easily explained by almost constant rotational velocities V for each of the four arbitrarily introduced spectral subgroups; in each subgroup (except BOV-B3V) the rotational velocities of stars in binary systems (including those rotating at synchronism) are smaller than those of single stars. (auth)

15521 BINARY SYSTEMS OF W URSAE MAJORIS TYPE (W UMa). PART I. Rucinski, S. (Univ., Warsaw). Postepy Astron.; 20: No. 4, 275-296(Dec 1972). (In Polish).

The article briefly discusses the observational facts concerning W UMa stars and contains a review of recent attempts to give a theoretical model (zero age or evolutionary) of these systems. (auth)

15522 FINAL STATES OF STELLAR EVOLUTION. Nemeth, Judit (Eoetvoes Lorand Univ., Budapest). Fiz. Szemle; 22: No. 11, 328-333(Nov 1972). (In Hungarian).

The rarity of supernova explosions indicates that most stars never reach that state, because the temperature required by the energetically feasible reactions is not reached at the center of the star. If the stellar mass is insufficient to provide the conditions needed for the formation of elements close to iron, the electron gas degenerates, the star slowly contracts and cools down, going into the white dwarf stage. The conditions involved in reaching that state are analyzed. The only possible source of energy for the luminosity of such a system is the residual thermal energy. The passage of the ^4He–^{12}C burning stars from the red giant to the white dwarf stage is briefly outlined. After a supernova explosion the high density of the residual mass enables the electrons to penetrate into the nuclei, forming neutrons with the protons, thus creating a neutron star. Stability relationships and the black hole, the third possible final state in the evolution of a star, is described. The most important relevant experimental observations, the discovering of pulsars and current theories of gravitational collapse, are also discussed. (Review article). (TTT)

15523 MASS TRANSFER IN CLOSE BINARIES. III. GASEOUS RINGS IN ALGOL-LIKE BINARIES. Kriz, S. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 23: No. 6, 328-331 (1972).

Using evolutionary models of Algol-like binaries, calculated theoretically, it was found that no gaseous rings should be generated in systems created during mass transfer in Case A, whereas in most systems created during mass transfer in Case B gaseous rings should be generated. (auth)

15524 SPATIAL SPECTROSCOPIC DIAGNOSTICS OF PLANETARY NEBULAE. III. NUMERICAL INVESTIGATION OF LOCAL ABSOLUTE MONOCHROMATIC ENERGIES AND LOCAL ABSOLUTE ENERGIES IN SPHERICALLY SYMMETRIC MODELS. Hekela, J.; Hubeny, I. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 23: No. 6, 331-341(1972).

Changes in line profiles and total intensities of emission lines were studied in dependence on an arbitrary rearrangement of ion abundance and turbulent and macroscopic velocities on the line of sight through the investigated gas. Due to the easy comparison of the individual line profiles and total line intensities, from different points of the disk, all computations were performed on spherically symmetric models of planetary nebulae. As the line profiles are formed only by Doppler effects, it was sufficient to study the shape of one selected line. The forbidden N_1 line (O III–λ 5007 Å) was chosen. The purpose of this paper was to clarify the individual effects caused by the structural functions, pointed out above, on emergent line profiles. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstract 15618.

15525 (AD-746464) ACCURATE POSITIONS FOR RADIO SOURCES. Cohen, M. H. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 17p. NTIS.

Fringe-rate residuals from observations with the Goldstack interferometer (d/Lambda =100 million at 3.8 cm) were analyzed. The positions for eleven sources, and the baseline, were obtained to an accuracy of about 0.2 second. Five sources were coincident with their associated optical objects to about 0.2 second. (auth)

15526 (N-72-25723) STUDY OF 2 TO 20 keV X RAYS FROM THE CYGNUS REGION. Bleach, R. D. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jun 1972. 130p. (NASA-TM-X-65903; X-661-72-152). NTIS.

Two rocket-borne proportional counters, each with 650 cm^2 area and 1.8 × 7.1° FWHM rectangular mechanical collimation, surveyed the Cygnus region in the 2 to 20 keV energy range on two occasions. X-ray spectral data gathered on September 21, 1970, from discrete sources in Cygnus are presented. The data from Cyg X-1, Cyg X-2, and Cyg X-3 have sufficient statistical significance to indicate mutually exclusive spectral forms for the three. Upper limits are presented for x-ray intensities above 2 keV for Cyg X-4 and Cyg X-5 (Cygnus loop). A search was made on August 9, 1971 for a diffuse component of x rays >1.5 keV associated with an interarm region of the galaxy at galactic longitudes in the vicinity of 60°. A statistically significant excess associated with a narrow disk component was detected. Several possible emission models are discussed, with the most likely candidate being a population of unresolvable low-luminosity discrete sources. (auth)

15527 BLACK HOLES AND SPINNING TEST BODIES. Rasband, S. N. (Louisiana State Univ., Baton Rouge). Phys. Rev. Lett.; 30: No. 3, 111-14(15 Jan 1973).

The orbit equations of Papapetrou are the basis for a study of spinning test bodies in a Schwarzschild or Kerr metric field. The constant of the motion for a Killing vector of an arbitrary metric field is given. An analysis of test-body equatorial motion suggests that significant departures from the results of geodesic motion such as larger maximum binding and orbits completely stable against capture may be expected for objects with large intrinsic spin. (auth)

15528 REDSHIFTS OF A BSO AND GALAXIES IN THE VICINITY OF THE RADIO SOURCE RN 8. Miller, J. S.; Robinson, L. B.; Wampler, E. J. (Univ. of California, Santa Cruz). Astrophys. J.; 179: No. 2, L83-L87(15 Jan 1973).

Spectrograms of a blue stellar object and five nearby galaxies in the vicinity of the radio source RN 8 were obtained with the 120-inch Lick reflector and image tube scanner. The BSO has a spectrum similar to Seyfert nuclei, and the measurement of five emission lines identified as Hα, Hβ, Hγ, and N_1 and N_2 of [O III] yielded a redshift z = 0.184. Three of the galaxies measured have redshifts very similar to that of the BSO. A fourth galaxy, considerably brighter than others in the field, appears to have a much lower redshift, while the fifth galaxy observed did not show any features suitable for a redshift determination. The large extent of RN 8 on the sky makes identification of the radio source with a particular optical object uncertain. (auth)

15529 GENERALIZED ANGULAR-VELOCITY FORMULA AND KINEMATICAL ANALYSIS OF 3C 279. Alvarez, E.; Bel, E. (Univ., Madrid). Astrophys. J.; 179: No. 2, 391-393(15 Jan 1973).

A figure has been given recently by Whitney for the relative angular velocity of the two radio components of 3C 279. Using the generalized redshift formula obtained previously and the generalized angular-velocity formula for uniform models, the kinematics of the two components of 3C 279 are analyzed using the figure mentioned before and several simplifying assumptions. (auth)

15530 ANALYSIS OF THE ABSORPTION SPECTRUM OF PHL 957. Bahcall, J. N.; Joss, P. C. (Inst. for Advanced Study, Princeton, NJ). Astrophys. J.; 179: No. 2, 381-389(15 Jan 1973).

Five absorption redshifts ranging from z = 2.67 to z = 2.22 were identified in the observed spectrum of PHL 957, in good agreement with the earlier analysis of Lowrance et al. The results were compared with an average of 1.0 ± 0.9 redshifts found in random-number spectra having the same essential characteristics as the observed spectrum. The distribution of identified absorption redshifts is presented and discussed for five quasars, whose rich absorption spectra have all been studied with the same methods as those used in the present investigation. (auth)

15531 SOFT-X-RAY SURVEY FROM THE GALACTIC CENTER TO CASSIOPEIA. Burginyon, G.; Hill, R.; Palmieri, T.; (and others) (Univ. of California, Livermore). Astrophys. J.; 179: No. 2, 615-625(15 Jan 1973).

Results are presented of a survey of the galactic plane between l^{II} = 0 and 145°. The detector was sensitive to x rays with energy from 0.2 to 18 keV and had an effective area of 640 cm^2. Source locations within 0.02 deg^2 and spectral parameters were derived for Cyg 1, Cyg 2, the Cygnus Loop, Ser 1, and the supernova remnant Cas A. Spectral parameters were also derived for GX 5 – 1, GX 9 + 1, GX 13 + 1, and GX 17 + 2; however, these sources were located in only one dimension. Some spectral information and locations in one dimension were obtained for Tycho's supernova remnant, Cyg 3, and seven other sources. The positions and those measured by the Uhuru satellite are in good agreement. The Cygnus Loop was observed during two nearly perpendicular scans. The data showed that the x-ray and radio objects have almost the same spatial extent but different intensity distributions. The northern part of the radio source, the region containing the brightest optical filaments, emits most of the x-ray flux. (auth)

15532 INTERPRETATION OF THE X-RAY EMISSION DETECTED FROM SOME NEARBY RADIO GALAXIES. Okoye, S. E. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 339-348(1972).

Values of the x-ray emission expected from nearby radio galaxies on the basis of the inverse Compton effect are derived. The theoretical results are discussed in the context of three nearby radio galaxies, for which recent observational data are available and from which x-rays have reportedly been detected. It is shown that the x-ray emission by the inverse Compton effect is small compared with observed levels if equipartition magnetic field strengths are assumed. The inverse Compton model may be saved by resorting to source magnetic field strengths less than equipartition values or by postulating highly leaky radio sources such that the Compton x-rays are generated mainly outside the radio volumes by escaped relativistic electrons which interact with the "3K" microwave background radiation. (auth)

15533 OBSERVATIONS OF RADIO SOURCES WITH AN INTERFEROMETER OF 24-KM BASELINE. 3. THE ANGULAR STRUCTURES AT 408 AND 1423 MHz OF 44 RELATIVELY INTENSE RADIO SOURCES. Wilkinson, P. N. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 305-319(1972).

The results of long baseline radio interferometer studies at 408 and 1423 MHz of the angular structures of a sample of relatively intense radio sources, mainly from the 3 CR catalogue, are presented. The Mk I– Mk III interferometer based at Jodrell Bank was used for this work; this instrument enabling radio components ≲1.2″ arc in half-power diameter at 408 MHz and ≲0.4″ arc in half-power diameter at 1423 MHz to be resolved. The sources were selected from the area of sky defined by δ > 20°; b^{II} > 20°, using the single criterion $S_{1420} \geq 3.2 \times 10^{-26}$ W m^{-2} Hz^{-1}. Four other sources not satisfying these selection criteria were also observed. The results of the model fitting analysis of the visibility data are given and discussed for each source, and some of the more interesting points arising from them noted. A detailed discussion of the results in comparison with other angular structure observations will be given in a later paper. (auth)

15534 MULTIFREQUENCY POLARIZATION OBSERVATIONS OF EIGHT EXTRAGALACTIC SOURCES. Gauss, F. S.; Goldstein, S. J. Jr. (Univ. of Virginia, Charlottesville). Astrophys. J.; 179: No. 2, 439-444(15 Jan 1973).

Observations of linear polarization in forty 5-MHz bands between 1250.4 and 1445.4 MHz showed the expected linear relation between position angle of the polarized vector and wavelength squared for eight sources. Seven of the sources had Faraday rotations in agreement with values in the literature obtained at higher frequencies. Upper limits to the difference in Faraday rotation of the two components of five double sources were derived. (auth)

15535 NEUTRON-STAR ACCRETION IN A STELLAR WIND: MODEL FOR A PULSED X-RAY SOURCE. Davidson, Kris; Ostriker, J. P. (Princeton Univ., NJ). Astrophys. J.; 179: No. 2, 585-598(15 Jan 1973).

Many of the characteristics of the pulsing x-ray sources Cen X-3 and Her X-1 are applicable in terms of a simple model. A rotating magnetized neutron star orbits a more massive slightly evolved star and accretes mass from the stellar wind emanating from that star. An analysis of the tidal disruption problem shows that the period, velocity amplitude, and eclipse duration of the x-ray source permit the neutron star to have a mass of 1 $M_\odot$, determine the inclinations to be 70 to 90°, and require separations, masses, radii, and spectral types of the companion stars to be approxi-

mately (18 $R_\odot$, 8 $R_\odot$), (20 $M_\odot$, 2 $M_\odot$), (12 $R_\odot$, 4 $R_\odot$), and (B2 III, F5 III), for Cen X-3 and Her X-1, respectively. Accretion rate is restricted to less than $10^{-7.4}$ $M_\odot$ per year in any case, by the Eddington limit, and calculated to be $\sim 10^{-9}$ $M_\odot$ per year—three orders of magnitude less than the moderate stellar winds required. Infalling gas interacting with the neutron star magnetosphere causes its rotation period to approach an equilibrium value which is on the order of seconds if the surface field is $\sim 10^{12}$ gauss. The x-ray spectrum coming from well-defined areas near each magnetic pole is also fixed by system parameters. The theory applied to Cen X-3 is consistent with a surface field of 10^{12} gauss and x-ray luminosity of $10^{36.5}$ ergs s^{-1}. (auth)

15536 OPTICAL CANDIDATE FOR GX 5-1. Webster, B. L. (Radcliffe Observatory, Pretoria). Nature (London) Phys. Sci.; 240: No. 104, 183(25 Dec 1972).

It is stated that a faint radio source has been detected within the "error box" of the x-ray source GX 5-1, and it has been suggested from optical considerations that the system may be similar to Cyg X-1. This possibility was investigated spectrographically with the Radcliffe image tube spectrograph incorporating a spectracon. No property was found making this object an obvious candidate for the x-ray source. (UK)

15537 IDENTIFICATION OF 2U 0525-06 WITH ξ^2 ORIONIS. Barbon, R.; Bernacca, P. L.; Tarenghi, M.; Treves, A. (Asiago Observatory, Italy). Nature (London) Phys. Sci.; 240: No. 104, 182-183(25 Dec 1972).

In a comparison of lists of collapsed star candidates with catalogues of x-ray sources it was found that ξ^2 Orionis was inside the "error box" of the x-ray source 2U 0525-06, and whether or not this "identification" is significant is discussed. Transfer of matter between the objects can occur only through a stellar wind. Comparisons are also made of 2U 0525-06 with Cyg X-1 (2U 1956 + 35). (UK)

15538 LORENTZ TRANSFORMATION PROPERTIES OF THE STOKES PARAMETERS. Cocke, W. J.; Holm, D. A. (Univ. of Arizona, Tucson). Nature (London) Phys. Sci.; 240: No. 103, 161-162(18 Dec 1972).

Reference is made to Ferguson (Nature Phys. Sci. 234: 86 (1971)) (and unpublished work) who interpreted the optical polarization of the Crab Nebula pulsar by a rotating relativistic vector model assuming that the percentage linear polarization of a collimated beam of light is the same when measured by observers in relative motion with respect to one another. This assumption led the present authors to investigate the general Lorentz transformation characteristics of partially elliptically polarized radiation, and in particular the transformation properties of the Stokes parameters. The problem has astrophysical interest not only for pulsars but also for other cosmic sources emitting elliptically polarized radiation, such as synchrotron sources. In discussing the transformation properties of the Stokes parameters for partially polarized light it was found convenient to use the quantum mechanical density matrix formalism, which allows treatment of the statistical concepts involved in a simple and unified manner. The results indicate that the observed percentages of polarization and the position angle of the polarization eclipse do not depend on any relative motion between the observer and the source. Polarization measurements may thus be made of any object without concern about relativistic effects on the polarization parameters. (UK)

15539 OBSERVATIONS OF RADIO SOURCES WITH AN INTERFEROMETER OF 24-KM BASELINE. 1. THE ANGULAR STRUCTURES AT 408 MHz OF 106 SOURCES FROM THE PARKES CATALOGUE. Critchley, J.; Palmer, H. P.; Rowson, B. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 271-282(1972).

The basic details of the Jodrell Bank-MkII telescope interferometer system are described. Angular size and structure information at 408 MHz on 106 sources from the Parkes catalogue in the range $-13° > \delta > -17°$ is presented. The data show that there is a larger fraction of double sources consisting of compact widely separated emitting regions than is apparent from published work. (auth)

15540 CYGNUS X-3 RADIO SOURCE. LOWER LIMIT ON SIZE AND UPPER LIMIT ON DISTANCE. Hinteregger, H. F. (Massachusetts Inst. of Tech., Cambridge); Catuna, G. W.; Counselman, C. C.; (and others). Nature (London) Phys. Sci.; 240: No. 103, 159-160(18 Dec 1972).

Interferometric observations were made of Cygnus X-3 in September 1972 using a pair of radio telescopes at Green Bank, W. Virginia, and another pair in Massachusetts. Details are given of the experimental procedure employed. The date indicated that, on the assumption that the source is circularly symmetric in projection, a lower limit of about 0.01 arc sec can be placed on its angular size, and an upper limit of 50 kpc on its distance, implying that Cygnus X-3 belongs to our galaxy. (UK)

15541 OBSERVATIONS OF RADIO SOURCES WITH AN INTERFEROMETER OF 24-KM BASELINE. 2. THE ANGULAR STRUCTURES AT 151 AND 408 MHz OF 46 UNIDENTIFIED RADIO SOURCES FROM THE REVISED 3C CATALOGUE. Wraith, P. K. (Univ. of Manchester, Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 283-303(1972).

The angular structures of 46 unidentified radio sources from the revised 3C catalogue have been determined with the Mk I-Mk III interferometer based at Jodrell Bank. The observations were made at 151 and 408 MHz simultaneously giving maximum resolving powers of ≈ 4 arcsec and ≈ 1.2 arcsec, respectively. Many of the sources have a double structure, the components of these double sources often having higher brightness regions toward their outer edges and lower brightness "tails" usually—but not always—pointing toward the centroid of the source. Only a few of the components in any of the sources studied have been resolved perpendicular to their direction of elongation. (auth)

15542 HIGH FREQUENCY OBSERVATIONS OF THE SECOND RADIO FLARE IN CYGNUS X-3. Lo, K. Y.; Spencer, J.; Crane, P. C.; Burke, B. F. (Massachusetts Inst. of Tech., Cambridge). Nature (London) Phys. Sci.; 240: No. 103, 158-159(18 Dec 1972).

It is stated that the radio source identified with Cygnus X-3 was observed throughout the second great flare on September 20–22, 1972 at 15.5 GHZ, using the 120 ft antenna of the Haystack Observatory at Westford, Mass. Two measurements at 22.235 GHZ and one at 8.105 GHZ were also made. Evidence of a third large flare was also present in the data. The measurement procedure is described; the flux was measured, during radio outbursts, relative to that of the H II region DR 21 and from the spectral indices the spectrum of the source was constructed for times corresponding to before, during and after the second flux maximum. Explanations are offered for the shapes of the spectra. (UK)

15543 MAGNETIC FIELD IN THE PLASMASPHERE OF A COMPACT STAR. Conen, R. H.; Coppi, B.; Treves, A. (Massachusetts Inst. of Tech., Cambridge). Nuovo Cim.; 13B: No. 1, 59-81(11 Jan 1973).

The main characteristics of the plasmasphere which is likely to surround a compact star, with a strong magnetic field and a relatively large velocity of rotation, are pointed out. Special reference is made to models for Sco X-1 and the pulsar NP 0532. A force-free magnetic field configuration is shown to be set up in the neighborhood of the star and the equation for the relevant magnetic surfaces is derived in the axisymmetric limit where the axis of rotation coincides with that of the star's intrinsic dipolar magnetic field. A proper asymptotic solution of this equation is obtained by considering as small parameters the poloidal angle within which current flows along magnetic field lines and the ratio of the toroidal magnetic field due to the current to the intrinsic stellar magnetic field. (auth)

15544 OPTICAL CANDIDATE FOR SMC X-1. Webster, B. L.; Martin, W. L.; Feast, M. W.; Andrews, P. J. (Radcliffe Observatory, Pretoria). Nature (London) Phys. Sci.; 240: No. 104, 183(25 Dec 1972).

It is stated that in addition to the known discrete x-ray source, SMC X-1, there are two relatively bright stars within the x-ray region of the Small Magellanic Cloud, one of which appears to be a foreground F star and the other (Sk 160) an early B supergiant, that, by analogy with HD 226868, may be emitting the x rays. A Carnegie image tube spectrogram of the first star shows it to be a low-velocity galactic F star, with the colours of a subdwarf. The second star (Sk 160) has been classified as B01, and the photometry was consistent with this classification; the radial velocity is also consistent with Cloud membership. If SMC X-1 and this second star are identical this would mean that the secondary component has a mass less than about 1.5 $M_\odot$. (UK)

15545 ROTATION IN HIGH-ENERGY ASTROPHYSICS. Pacini, F.; Rees, M. J. Sci. Amer.; 228: No. 2, 98-105(Feb 1973).

The sources of energy of pulsars, quasars, and other strange objects are discussed and the pulsar model is extrapolated to quasars and spinars. It is conjectured that gravitational energy converted into rotational energy as a large object contracts into a small one may be the source of energy for quasars and radiogalaxies. (WDM)

15546 DISTRIBUTION FUNCTIONS OF QUASARS. Dobrovol'skii, O. V. (Inst. of Astrophysics, Stalinabad, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 11, 14-18(1972). (In Russian).

The distribution of quasars was considered simultaneously on the basis of the amount of redshift and the galactic latitude in the

N and S galactic hemispheres. The influence of absorbing material in the galaxies on the visible distribution of quasars in the stellar sphere is discussed. The decrease in average brightness of quasars with increase in their redshift may thus be corroborated, and it is suggested that the quantitative character of this decrease in average brightness may be of considerable cosmological significance. (KSW)

Solar Phenomena

Refer also to abstracts 15629, 15650, 15704, 15963, and 16263.

15547 (AD-746290) GEOPHYSICS AND SPACE DATA BULLETIN. VOLUME IX, NUMBER 1. FIRST QUARTER 1972. Carrigan, A. L. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). Jun 1972. 321p. (AFCRL-72-327; AFCRL-SR-137). NTIS.

This Bulletin is a quarterly publication that contains AFCRL contract and inhouse data reported from sites throughout the world. Program descriptions for all data sections are updated annually or as required, and are presented. The following types of data are contained within each issue: magnetometer, cosmic ray, ELF noise, riometer, solar optical and radio emission, and ionosonde. This issue covers such data for January, February, and March 1972. (auth)

15548 (AD-747021) RADIO OBSERVATIONS OF THE DISTRIBUTION OF THE CHROMOSPHERIC BRIGHTNESS TEMPERATURE. Shimabukuro, F. I.; Simon, M.; Buhl, D.; Cogdell, J. R.; Zapata, C. (Aerospace Corp., El Segundo, Calif.). 1 Mar 1972. Contract F04701-71-C-0172. 15p. (SAMSO-TR-72-127). NTIS.

Radio observations of the solar eclipse of March 7, 1970, were made at several observatories in a cooperative effort, covering a wavelength range of 2.1 mm to 2 cm. An analysis of the radio observations is given. (auth)

15549 (AD-747033) MODEL FOR U-SHAPED SOLAR BURST SPECTRA. Kalman, Gabor; Yukon, Stanford; Bakshi, Pradip (Boston Univ., Mass. Dept. of Physics). May 1972. Contract F19628-72-C-0003. 63p. (AFCRL-72-324). NTIS.

A model, for U-shaped solar bursts based on one single group of moderately relativistic electrons radiating in an ambient cold magnetoplasma is presented. Results of computer calculations are discussed. Suggestions for comparison with observation are made. Speculations about the mechanism of proton acceleration are included. (auth)

15550 (AD-747965) LARGE-SCALE PHOTOSPHERIC MAGNETIC FIELD: THE DIFFUSION OF ACTIVE REGION FIELDS. Schatten, K. H.; Leighton, R. B.; Howard, Robert; Wilcox, J. M. (Stanford Univ., Calif. Inst. for Plasma Research). May 1972. Contract N00014-67-A-0112-0068. 17p. (SU-IPR-472). NTIS.

The large-scale photospheric magnetic field has been computed by allowing observed active region fields to diffuse and to be sheared by differential rotation in accordance with the Leighton (1969) magnetokinematic model of the solar cycle. The differential rotation of the computed field patterns as determined by autocorrelation curves is similar to that of the observed photospheric field, and poleward of 20° latitude both are significantly different from the differential rotation of the long-lived sunspots (Newton and Nunn, 1951) used as an input into the computations. (auth)

15551 (N-72-27831) SOLAR WIND PHYSICS. Semiannual Status Report. (Wisconsin Univ., Madison. Dept. of Physics). Jun 1972. 60p. (NASA-CR-127274). NTIS.

A double-chambered gas proportional counter was constructed to detect and identify solar wind ions after acceleration by a high-voltage power supply. It was determined that the best method of detecting deuterium in the solar wind is to use a tritium target as proposed for IMP H and J. The feasibility of detecting H(+) and He(+) ions of interstellar origin is considered. A program is described to carry out ground-based astronomical observations of faint, diffuse optical emission lines from interstellar gas. Hydrogen and oxygen emission lines from galactic sources were detected and the galactic and geocoronal H alpha and beta lines were clearly resolved. (STAR)

15552 (N-72-27835) ANISOTROPIES IN THE INTERPLANETARY INTENSITY OF SOLAR PROTONS $E_p > 0.3$ MeV. Innanen, W. G.; VanAllen, J. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Jun 1972. Contract NAS5-9076. 69p. (NASA-CR-127425). NTIS.

From the data on solar protons with energy >0.3 MeV obtained by Explorer 35 since July 1967, ten events were selected for the study of intensity vs time and of angular distributions of intensity in interplanetary space near the Earth. The bases of selection were that the events be of adequate intensity for statistically satisfactory study and that they be attributable to a single solar flare so that their time histories were not complicated by overlapping emissions of particles. The principal findings for these events are presented. (auth)

15553 SOLAR NEUTRINO PROBLEM: A PROGRESS (?) REPORT. Trimble, Virginia; Reines, Frederick (Univ. of California, Irvine). Rev. Mod. Phys.; 45: No. 1, 1-5(Jan 1973).

The conflict between observation and theoretical prediction of the flux of electron neutrinos from the Sun has advanced in the past year from being merely difficult to understand to being impossible to live with. Attempts to explore the nature of the conflict, to seek possible ways out of it, and to inquire into additional experiments that have the capability either of resolving the conflict or at least of deciding which branch of physics or astrophysics is responsible for it are reviewed. (auth)

15554 HEIGHTS OF CALCIUM FLOCCULAE. Musaev, M. M. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 8, 10-11(Aug 1971). (In Russian).

Experiments were conducted for the purpose of evaluating the height of calcium flocculae and their displacement from the magnetic components in the photosphere and chromosphere. Simple triangulation was employed to establish the height of localization of the flocculae from such displacement: 1300 to 1600 km. (KSW)

15555 B-COMPONENT OF SOLAR RADIO EMISSION. Abbasov, A. R. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 1, 9-11(Jan 1971). (In Russian).

Formulas are discussed for determining the true B-component of solar activity, allowing for, and disregarding the radio emission. The difference between these two values when plotted against λ over the range 0 to 30 cm exhibited a sharp maximum at $\lambda \sim 10$ cm. (KSW)

15556 TURBULENT HEATING OF COLLIDING STREAMS IN THE SOLAR WIND. Goldstein, M. L.; Eviatar, Aharon (Tel-Aviv Univ., Israel). Astrophys. J.; 179: No. 2, 627-636 (15 Jan 1973).

Turbulent heating of colliding plasma streams has previously been observed in the solar wind. The original data were interpreted in terms of a fluid model. It is argued that a plasma-kinetic description is the more appropriate theoretical approach and is necessary in order to better understand the microscopic physical phenomena that underlie all fluid models. Microscopic solar-wind parameters characteristic of conditions during the observations were used, together with the quasi-linear plasma-kinetic theory, to compute the expected magnetic field and temperature enhancements in the interaction region between two counterstreaming plasma beams. The physical mechanism of excitation is the electromagnetic two-stream instability in which Alfvén waves are unstable. A total field in the interaction region of $B \sim 8\gamma$ (10 to 12 γ is observed) and a change in temperature of $\Delta T \sim 1 \times 10^5$°K ($1 - 2 \times 10^5$°K is observed) were computed. Other features of the observations are discussed in terms of a plasma-kinetic theory. (auth)

15557 HEAT CONDUCTIVITY, PLASMA INSTABILITIES, AND RADIO STAR SCINTILLATIONS IN THE SOLAR WIND. Perkins, F. (Princeton Univ., NJ). Astrophys. J.; 179: No. 2, 637-642(15 Jan 1973).

The motion of a typical solar-wind electron is periodic because of the combination of magnetic mirror and electrostatic reflections. The periodic motion reduces the electron heat conductivity from the Spitzer formula and causes magnetoacoustic waves with an inward-directed phase velocity to become unstable. A nonlinear theory of this instability quantitatively accounts for radio-star scintillation data and an increased rate of energy exchange between electrons and ions above the Spitzer value. (auth)

15558 OBSERVATIONS OF THE VARIATION OF TEMPERATURE WITH LATITUDE IN THE UPPER SOLAR PHOTOSPHERE. II. MAGNETIC-FIELD COMPARISON, IMPLICATIONS FOR SOLAR-OBLATENESS MEASUREMENTS, AND HARMONIC ANALYSIS. Canfield, R. C. (Sacramento Peak Observatory, CA). Astrophys. J.; 179: No. 2, 643-650(15 Jan 1973).

It is shown that there is a close relationship between the latitudinal variation of upper-photospheric temperature and that of photospheric magnetic field. This correlation, when used with 1966 magnetic-field data, implies that very little of Dicke and Goldenberg's solar-oblateness signal was due to pole-equator temperature differences at small optical depths. Legendre-polynomial representations of the temperature-difference data are given. (auth)

15559 SHOCK-TUBE MEASUREMENTS OF ABSOLUTE gf-VALUES FOR Ti I AND Ti II. Wolnik, S. J.; Berthel, R. O. (Air Force Cambridge Research Labs., Bedford, MA). Astrophys. J.; 179: No. 2, 665-670(15 Jan 1973).

Absolute gf-values for 97 Ti I and 30 Ti II lines were determined by shock-tube emission spectroscopy. Comparisons were made with other experimental results. Implications concerning the titanium abundance in the solar photosphere are discussed. (auth)

15560 NEUTRON MONITOR ON A SATELLITE WITH A HIGHLY ELLIPTIC ORBIT. Shavrin, P. I.; Samonenko, Yu. A.; Razumov, Yu. A.; (and others) (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 158-161(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 184-187(1972).

A brief description is given of the neutron monitor on Molniya 1, launched November 27, 1970, on a semi-synchronous orbit. The effectiveness of the method proposed for determining the intensity and energy spectrum of solar protons is illustrated by an analysis of data obtained during the proton flare of January 25, 1971. (auth)

15561 CHARACTERISTICS OF THE DEVELOPMENT OF ACTIVE REGIONS WITH PROTON FLARES. Kuleshova, V. P. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 288-289(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 328(1972).

Data from 25 solar active regions where 33 proton flares occurred during the IGY were investigated, compared, and analyzed. Forecasts of geophysically effective flares are important in the short-range forecasting of ionospheric-magnetic disturbances. Proton flares have the strongest geophysical effect. The characteristics of the solar active regions with proton flares are studied, assuming conditionally that proton flares are those that are accompanied by type-IV radio bursts and produce polar-cap absorption after 1 to 7 hours and a sudden-commencement storm after approximately 2 days. Many features of the solar active regions are discussed for the determination of their relation to flares, proton or nonproton. Analyses were made from photoheliograms taking the coordinates of the center of each spot in an active group where the flares in question occurred on each day and constructing a schematic image of the region in rectangular coordinates. Data were computed for two stable spots of a given group of opposite polarity: the diurnal rotation of the axis connecting two stable spots in degrees and the diurnal variation of the horizontal gradient of the magnitude of the magnetic field of a pair of stable spots. Conclusions are enumerated. (JCW)

15562 CYCLICITY AND GEOMETRY OF THE SOLAR WIND. Chirkov, N. P. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 291-292(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 331-332(1972).

It is shown that geomagnetic activity is asynchronous in even and odd solar-activity cycles. The geomagnetic-activity maximum occurs 2 to 5 years after the solar-activity maximum in even cycles and 1.5 to 2 years after in odd cycles. The geomagnetic-activity maximum is more pronounced in even than in odd cycles and the lowest magnetic activity occurs at the beginning of an even cycle. There is a geomagnetic-activity cycle of approximately 21 years. Cosmic-ray intensity variations are associated with the velocity and geometry of the solar wind, and results indicate that solar-wind geometry differs significantly in even solar-activity cycles from that in odd cycles. The existence of 21- and 4-year cycles in geomagnetic activity makes it possible to forecast it for the near future. For example, in solar activity cycle 20, a geomagnetic-activity maximum is expected, and a maximum solar wind is expected in 1972–1973. (JCW)

15563 EFFECTS OF SUDDEN MIXING IN THE SOLAR CORE ON SOLAR NEUTRINOS AND ICE AGES. Ezer, D.; Cameron, A. G. W. (Yeshiva Univ., New York). Nature (London) Phys. Sci.; 240: No. 104, 180-182(25 Dec 1972).

It is stated that continuous mixing throughout much of the solar interior might maintain a large abundance of hydrogen at the center of the Sun, resulting in a lowering of the temperature relative to an unmixed model and lowering of the ^8B neutrino flux by a factor of about 4. Although this suggestion is unconventional and not very attractive in terms of present stellar evolution theory, it may be worth consideration in view of the solar neutrino problem. Another suggestion (Fowler, Nature 238: 24(1972)) is that solar neutrino generation may have been temporarily shut off at the center of the Sun for some reasons, and this suggestion prompted the present authors to make some numerical experiments with an appropriate solar model. The simplest way to reduce the neutrino flux from the center of the Sun on a temporary basis is to release a certain amount of energy there; this would cause an expansion of the solar core, lower the temperature at the solar center, and reduce the rates of all the nuclear reactions. As the additional energy diffused out of the interior the core would settle towards its original configuration and the neutrino fluxes would recover their original values. Ways in which a relatively sudden release of energy could occur in the solar core are discussed together with plausible mechanisms by which sudden mixing could be produced. Concerning luminosity, if the foregoing is the resolution of the solar neutrino problem, the Sun should at present have a luminosity much reduced from its normal level, suggesting that the Earth has been undergoing an ice age for the past 2×10^6 years, and is at present at an interglacial period. (UK)

15564 MIXED-UP SUN AND SOLAR NEUTRINOS. Rood, R. T. (California Inst. of Tech., Pasadena). Nature (London) Phys. Sci.; 240: No. 104, 178-180(25 Dec 1972).

Fowler's suggestion (Nature 238: 24(1972)) that the negative result of effort to detect neutrinos from the Sun might be due to the Sun being in a transient phase after "mixing" some millions of years ago is examined in detail. Models for the mixing mechanism are discussed, including effects on neutrino flux. (UK)

15565 NUMERICAL STUDIES OF THE TRANSPORT OF SOLAR PROTONS IN INTERPLANETARY SPACE. Webb, S.; Quenby, J. J. (Imperial Coll. of Science and Tech., London). Planet. Space Sci.; 21: No. 1, 23-42(Jan 1973).

Numerical solutions of the Fokker–Planck equation governing the transport of solar protons are obtained using the Crank–Nicholson technique with the diffusion coefficient represented by $K_r = K_0 r^b$ where r is radial distance from the Sun and b can take on positive or negative values. As b ranges from +1 to −3, the time to the observation of peak flux decreases by a factor of 5 for 1 MeV protons when $V/K_0 = 3\ AU^{b-1}$ where V is the solar-wind speed. The time to peak flux is found to be very insensitive to assumptions concerning the solar and outer scattering boundary conditions and the presence of exponential time decay in the flux does not depend on the existence of an outer boundary. At $V/K_0 \gtrsim 15\ AU^{b-1}$, 1 MeV particles come from the Sun by an almost entirely convective process and suffer large adiabatic deceleration at $b \lesssim 0$ but for $b = +1$, large Fermi acceleration is possible at all reasonable V/K_0 values. Implications of this result for the calculation and measurement of particle diffusion coefficients is discussed. At $b \gtrsim 0$, the pure diffusion approximation to transport overestimates by a factor 2 or more the time to peak flux but as b becomes more negative, the additional effects of convection and energy loss become less important. (auth)

15566 IS THERE A TENTH PLANET IN THE SOLAR SYSTEM? Rawlins, D. (Coll. of Notre Dame of Maryland, Baltimore); Hammerton, M. Nature (London); 240: No. 5382, 457 (22 Dec 1972).

An attempt was made to establish the limits of the possible position of a tenth planet working from data on Neptune, which was chosen because it is the most sensitive of the known planets to the pull of a possible exterior body and the least affected by uncertainties in the masses of its known planetary neighbors. Perturbation theory was used and a least squares differential analysis was carried out, assuming circular orbits for any perturbing body. The only satisfactory solutions found were for bodies whose orbits lay between 50 and 100 AU and whose positions lay within a relatively small sector of the ecliptic. The existence of such a planet is not definitely asserted, and the results merely delimit the space wherein it might be found. (UK)

15567 SOLAR ENERGETIC PARTICLES AND WIDE-BAND CONTINUUM STORMS FROM METRIC TO HECTOMETRIC FREQUENCIES. Sakurai, K. (Goddard Space Flight Center, Greenbelt, MD). Planet. Space Sci.; 21: No. 1, 17-22(Jan 1973).

In association with solar flares accompanying Type IV radio bursts of U-shaped spectrum, solar cosmic rays (MeV) and energetic electrons (keV) were generated. After acceleration, they were first stored in or near the flare regions and then gradually emitted into outer space. It seems that the streams of keV electrons generated the continuum radio emissions from metric to hectometric frequencies while passing through the outer coronal regions. (auth)

15568 SOLAR-TERRESTRIAL RELATIONS. Beuermann, K.; Reinhard, R.; Richter, A.; Wibberenz, G. Atomkernenergie; 20: No. 3, 195-204(Dec 1972). (In German).

A correlation exists between the 169 MHz radio emission and the green coronal line ($\lambda = 5303$ Å) on the one side and the solar-wind velocity in the neighborhood of the Earth's orbit on the other side. This correlation is examined using additional information from euv-spectraldiagrams and from the distribution of the

solar magnetic field. A detailed analysis of the interplanetary magnetic field is made for March 1966. During this period a number of H_α- and proton flares emerged, among which one event with nearly scattering free expansion of protons was observed. For this event the structure of the interplanetary magnetic field and its influence on the propagation of protons was examined in detail. In a data-collection 90 solar flare events since 1942 are registered with regard to their characteristic features. Finally the acceleration of protons by Fermi-mechanism in interplanetary space is discussed. (auth)

15569 DETERMINATION OF THE STRENGTH OF THE C WING ALONG THE PROFILE OF THE IR TRIPLET LINES OF Ca II. Melikov, G. O. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 5, 3-5(May 1971). (In Russian).

Data previously reported by the author on the ir triplet Ca II lines at the center and edge of the solar disc were used to determine the strength of the C wing at those same locations. The data for λ = 8498, 8542, and 8662 Å were compared with those obtained by J. Hautgast (1942). (KSW)

15570 ASYMMETRY IN EMISSION PROFILES AND DYNAMIC PROCESSES IN CHROMOSPHERIC FLARES. Guseinov, R. E. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 3-6(Jun 1971). (In Russian).

Data previously published by the author formed the basis for a discussion of dynamic processes in chromospheric flares. Asymmetry in emission profiles exhibited two kinds of motion in flares: oriented motion of turbulent elements, and oriented motion of separate layers with a velocity gradient according to depth. (KSW)

15571 Sr II LINE AT 4077.7 A IN THE SPECTRUM OF ACTIVE SOLAR REGIONS. Musaev, M. M. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 7, 12-15(Jul 1971). (In Russian).

The typical contour of the line λ = 4,078 Å in the spectrum of a solar flare is graphically depicted and the center and wings of this line are discussed. An increase in the degree of ionization lead to a noticeable increase in the frequency of collisions of Sr II ions, since the cross section of ion–proton encounters is several orders greater than that of ion–hydrogen collisions. The profile of the absorption coefficient consequently expands as a result. (KSW)

15572 OBSERVATION OF CORONAL PROMINENCES ON THE SOLAR DISC. Karaev, A. A.; Mamedov, S. G.; Orudzhev, E. Sh.; Seidov, A. G. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 7, 3-5(Jul 1971). (In Russian).

A series of observations was made on a selected area of the solar disc for H_α and K Ca II lines using a horizontal solar telescope. The results of a search for coronal prominences are presented (as distinguished from recurring prominences), and radial velocities of up to 30 to 40 km/sec were recorded. (KSW)

15573 DEPENDENCE OF THE INTENSITY OF BALMER EMISSION LINES OF HYDROGEN, AVERAGE SOURCE FUNCTION, AND EXCITATION TEMPERATURE ON THE VELOCITY OF TURBULENT MOTION IN CHROMOSPHERIC FLARES. Guseinov, R. E. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 5, 9-11(May 1971). (In Russian).

Several important parameters of chromospheric flares were investigated as functions of the velocity of turbulent motion in their formation. Observations in weak flares in 1959 and 1960 of the intensities of Balmer emission lines of hydrogen in their spectra showed that the growth in turbulent velocity was accompanied by an increase in the average function of sources, and a decrease in the former was accompanied by a decrease in the latter. This was interpreted as part of the kinetic energy of turbulent motion being consumed in increased excitation. (KSW)

15574 CALCULATION OF THE PROFILES OF THE H AND K Ca II EMISSION LINES ACCORDING TO THE PHOTON ESCAPE PROBABILITY THEORY. Mamedov, S. G.; Orudzhev, E. Sh. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 13-16(Jun 1971). (In Russian).

Calculations are presented for the profiles of emission of the Ca II lines H and K for different values of the optical thickness and survival coefficients of original sources. The calculations were based on the probability theory of photon output from the medium. (KSW)

15575 SOURCES OF RADIO WAVES ASSOCIATED WITH SUNSPOTS. Abbasov, A. R.; Panova, N. D. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 6, 10-12(Jun 1971). (In Russian).

An analysis was made of daily observations of sunspots and radio emission, making allowance for directional effects of the radio-sources on the solar disc by breaking up the latter into two zones. The density of flux of radio radiation from the Sun was determined for each of the wavelengths of 3.2, 3.4, 6, 8, 11, 15, 20, 30, 50 cm. The flux densities were related to the areas of given sunspots of groups of sunspots. (KSW)

15576 TECHNIQUES USED IN THE SEARCH FOR LOW CONTRAST DETAILS ON THE SURFACE OF THE SUN. Mamedov, S. G.; Seidov, Z. F. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 9, 11-12(Sep 1971). (In Russian).

The problems involved in studying details on the solar surface which are similar in light output are discussed. It is proposed to solve many of these problems with an apparatus analogous to a spectroheliograph with small dispersion, of the order of 150 to 200 Å/mm. The advantages of the proposed technique are advanced. (KSW)

15577 TWO LONG-LIVED CORONAL PROMINENCES OBSERVED ON THE SOLAR DISC. Karaev, A. A.; Mamedov, S. G.; Orudzhev, E. Sh. Tr. Shemakh. Astrofiz. Observ., Akad. Nauk Azerb. SSR; No. 9, 7-10(Sep 1971). (In Russian).

Two coronal prominences were observed on June 15, 1970 and February 2, 1971. The first showed intense emission in the K Ca II line and lasted about 3 hr. The second had a radial velocity of 35 km/sec and lasted at least for one hour. Special features of the spectra of these prominences are discussed. (KSW)

15578 MAGNETIC IRREGULARITIES IN INTERPLANETARY SPACE AND GEOMAGNETIC ACTIVITY. Bavassano, B.; Conforto, A. M.; Ludovici, B. (Univ., Rome). Nuovo Cim.; 13B: No. 1, 161-173(11 Jan 1973).

The magnetic-field data provided by the space probe Pioneer 8 were studied in connection with some of the interplanetary shock waves observed during 1968 and accompanying geomagnetic disturbances. Different scales of the interplanetary magnetic field irregularities were investigated by using a smoothing method of computation of the variance. The influence of the various scales of irregularity upon the geomagnetic activity was examined by means of the usual method of statistical correlations with K_p indices. A particularly interesting result was that relative to the space coherence of magnetic irregularities. (auth)

15579 METHOD OF CALCULATING THE PITCH ANGLE DISTRIBUTIONS OF PARTICLE FLUXES BASED ON ROCKET AND SATELLITE DATA. Richter, K. (Max-Planck-Institut fuer Aeronomie, Lindau, Ger.). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 4, 32-36(Aug 1972).

A method of calculating pitch angle distributions of fluxes of charged particles in a magnetic field based on rocket and satellite data is described. The accuracy of this method is estimated and a sequence of instructions is given to help in performing such calculations. (auth)

15580 X-RAY EMISSION OF CORONAL CONDENSATIONS DURING THE ECLIPSE ON 20 MAY 1966 AND ITS CONNECTION WITH OPTICAL AND RADIO OBSERVATIONS. Letfus, V. (Astronomical Inst., Ondrejov, Czech.); Livshits, M. A. Bull. Astron. Inst. Czech.; 23: No. 6, 307-314(1972).

The electron temperature and the emission measure of three coronal condensations over active regions were derived from x-ray observations made on the SOLRAD 8 satellite during the May 20, 1966 eclipse. For the analysis it was necessary to distinguish the "quiet" level values from those affected eventually by any activity phenomena. A small x-ray burst occurring during the time of observation was unambiguously associated with a chromospheric flare, observed in the unocculted western sunspot group. This disclaims Meisel's (1968, 1970) hypothesis about the reflection of the lunar limb at grazing incidence. Correct integral fluxes at 0 to 8 Å and 8 to 12 Å are given. The x-ray data were compared with the optical and radio data, characterizing the investigated coronal condensations. Good correlation between the 8 to 12 Å x-ray fluxes and green line intensities of all three coronal condensations signified that both types of emission are controlled by the corresponding emission measures. The 0 to 8 Å fluxes, which do not correlate with the green line emission, are sensitive to arbitrary nonstationary processes connected with the formation of small high-temperature regions, or with the acceleration of electrons. (auth)

15581 FUNNEL PROMINENCES. Kleczek, J. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 23: No. 6, 315-318(1972).

Properties of funnel prominences were deduced from prominence surveys and prominence films. Association with active regions is discussed for 284 funnel prominences observed in H-alpha filter from January 1956 to December 1961. No conspicuous preference for specific spotgroup type, neither in Zürich, nor in Mt. Wilson magnetic classification, was found. Funnels were often associated

with plages without spotgroups. The outflow of the H-alpha material from the prominence body was connected with internal motions. A characteristic feature of internal motions is a substantial simplification of the prominence structure: the last phase of some funnels is one or more smooth regular loops. (auth)

15582 X-RAY EMISSION AND D-REGION "SLUGGISHNESS." Valnicek, B. (Astronomical Inst., Ondrejov, Czech.); Ranzinger, P. Bull. Astron. Inst. Czech.; 23: No. 6, 318–322(1972).

By comparing the direct flow of solar x rays at 1 to 6 A, recorded by the Intercosmos 1 satellite, with the records of atmospherics and other ionospheric effects the value of the sluggishness Δt of the ionospheric D region was found to vary. This value clearly depends on the spectral composition of the x rays, so that Δt is small with phenomena displaying larger energies, and Δt increases for lower emission energies and may reach values in excess of 10 minutes. (auth)

15583 CATALOGUE OF 260 MHz SOLAR RADIO NOISE STORMS (ONDŘEJOV 1962–1971). Olmr, J.; Sebl, J.; Tlamicha, A. (Astronomical Inst., Ondřejov, Czech.). Bull. Astron. Inst. Czech.; 23: No. 6, 323–327(1972).

A list is given of solar radio noise on the 115 cm wave-length recorded at Ondřejov, over the years 1962–1971. The list is a continuation of the catalog of 130 cm solar radio noise storms, recorded at Ondřejov during the years 1959–1961. (auth)

Galaxies

15584 (AD–747993) NEUTRAL HYDROGEN STUDY OF THE COMPACT GALAXY II ZW 40. Gottesman, S. T.; Weliachew, L. (Owens Valley Radio Observatory, Pasadena, Calif.). 1972. Contract N00014-67-A-0094-0019. 21p. NTIS.

Interferometric observations at the 21 cm neutral hydrogen emission line yielded information about the dynamics and structure of the compact galaxy II Zw 40. The neutral hydrogen follows a core-halo distribution with characteristic gaussian half-power widths of 52 arc sec and 350 arc sec. (auth)

15585 DEUTERIUM IN THE ORION NEBULA. Jefferts, K. B. (Bell Telephone Labs., Inc., Murray Hill, NJ); Penzias, A. A.; Wilson, R. W. (Astrophys. J.; 179: No. 2, L57–L59(15 Jan 1973).

Line emission attributed to the $J = 2$ to $J = 1$ transition of DCN was found in the Orion Nebula. This identification was strengthened by detection of the corresponding $J = 1$ to $J = 0$ multiplet. The measured frequencies, line shapes, and the line intensity ratio all agreed with the predictions based upon the identification. The computed column density was 4.3×10^{12} molecules per cm^2. (auth)

15586 OBSERVATIONS OF THE GALACTIC NUCLEUS AT 350 MICRONS. Gezari, D. Y.; Joyce, R. R.; Simon, M. (State Univ. of New York, Stony Brook). Astrophys. J.; 179: No. 2, L67–L70(15 Jan 1973).

Regions in the galactic center in the far-infrared were observed and the flux $(3.91 \pm 0.76) \times 10^{-11}$ W m^{-2} from Sgr B was detected and an upper limit 1.5×10^{-11} W m^{-2} was obtained from Sgr A, corresponding to flux densities at 350 μ of $(4.30 \pm 0.86) \times 10^{-22}$ and 1.6×10^{-22} W m^{-2} Hz^{-1}, respectively. Scanning observations of Sgr B in right ascension indicated that the width of the source is 5 to 10′. A close association between the far-infrared source and the molecular region in Sgr B was indicated, and an optically thin thermal model for the far-infrared radiation from dust grains is discussed. (auth)

15587 3C 299: A FAINT RADIO GALAXY OF INTERMEDIATE REDSHIFT. Spinrad, H.; Smith, H. E. (Univ. of California, Berkeley). Astrophys. J.; 179: No. 2, L71–L72(15 Jan 1973).

3C 299 is optically identified with a double-nucleus, 18.4 (red) magnitude radio galaxy. It has a high excitation emission line spectrum which yields $z = 0.367$. (auth)

15588 SPECTROPHOTOMETRY OF TON 524a, b. Robinson, L. B.; Wampler, E. J. (Univ. of California, Santa Cruz). Astrophys. J.; 179: No. 2, L79–L82(15 Jan 1973).

Spectra of Ton 524a, b show that these two compact emission-line galaxies have nearly identical redshifts. This is the first pair of Seyfert-like galaxies that appear to form a physical pair. (auth)

15589 BROAD COMPONENT OF Hα IN THE SEYFERT GALAXY NGC 5548. Ptak, R. L.; Stoner, R. E. (Bowling Green State Univ., OH). Astrophys. J.; 179: No. 2, L89–L92 (15 Jan 1973).

The broad component of the Hα emission from NGC 5548 is in excellent agreement with a profile calculated from a new model for the source of this radiation. In the model, protons are ejected with energy greater than 200 keV from a small source and subsequently stream outward through uniformly dense, partially ionized hydrogen gas. The broad Hα component arises from photons emitted from those protons that have picked up electrons during the process of slowing down to thermal energies. (auth)

15590 OPTICAL POLARIZATION IN THE NUCLEI OF E GALAXIES. Heeschen, D. S. (National Radio Astronomy Observatory, Green Bank, WV). Astrophys. J.; 179: No. 2, L93–L96(15 Jan 1973).

Observations were made of optical polarization in the nuclei of several giant elliptical galaxies. (auth)

15591 OPTICAL POLARIZATION IN THE NUCLEUS OF M87. Kinman, T. D. (Kitt Peak National Observatory, Tucson, AZ). Astrophys. J.; 179: No. 2, L97–L99(15 Jan 1973).

Heeschen's discovery of significant linear polarization in the ultraviolet radiation of the nucleus of M87 (NGC 4486) is confirmed. There is evidence that this polarization is variable. (auth)

15592 SEARCH FOR HARD X RAYS FROM EXTRAGALACTIC OBJECTS. Laros, J. G.; Matteson, J. L.; Pelling, R. M. (Univ. of California, San Diego). Astrophys. J.; 179: No. 2, 375–380(15 Jan 1973).

Three known extragalactic sources — M87, M31, and 3C 273 — were studied in the 20- to 300-keV range from balloons in 1970. With the possible exception of M87, a null result was obtained in each case. To reconcile the M87 measurement of $(4 \pm 2) \times 10^{-10}$ ergs cm^{-2} s^{-1} between 19 and 50 keV with the other x-ray data requires time variability or a two-component emission model. However, the lack of strong evidence for either hypothesis and the statistical uncertainties in this measurement should be noted. The 3 σ upper limits obtained for M31 and 3C 273 were 2×10^{-4} photons cm^{-2} s^{-1} keV^{-1} averaged from 20 to 100 keV. The M31 upper limit is incompatible with the assumption that normal galaxies produce the diffuse x-ray component. The hard x-ray emission from 3C 273 is less than 4×10^{46} ergs s^{-1} compared to an observed output of 4×10^{45} ergs s^{-1} in the 2- to 10-keV range and $\sim 10^{47}$ ergs s^{-1} in the infrared, assuming a distance of 630 Mpc. (auth)

15593 NONAXISYMMETRIC KINEMATICS IN GALAXIES WITH AXISYMMETRIC MASS DISTRIBUTIONS. Berry, C. L. (Univ. of Chicago). Astrophys. J.; 179: No. 2, 395–415(15 Jan 1973).

The dynamics of a galaxy with an axisymmetric, time-independent mass distribution but a nonaxisymmetric, time-dependent distribution of stars in phase space were investigated. The system considered is of infinitesimal thickness, and the motion of a star thus has two degrees of freedom. Associated with this motion is a third isolating integral in addition to the energy and the angular momentum. Under the conditions that the galaxy is in rapid rotation and that nonaxisymmetries associated with the additional integral are weak, solutions to Liouville's equation are developed as formal series in a small parameter which measures the deviation of a star's orbit from a circle. It is found that such a galaxy must have a gravitational potential for which the frequencies of the epicyclic and azimuthal motions of a star are nearly commensurate in a uniformly rotating frame of reference. The observed rotation curves of several systems, including the Galaxy, satisfy this condition remarkably well. For these galaxies, even in the absence of nonaxisymmetries in the mass distribution, coherent, nonaxisymmetric patterns in the stellar motions can persist for times of the order of 10^9 years. An elementary model showing nonaxisymmetric differential motions and a deviation of the vertex is presented. (auth)

15594 OBSERVATIONS OF MASS MOTIONS IN MARKARIAN 78. Adams, T. F. (Univ. of Arizona, Tucson). Astrophys. J.; 179: No. 2, 417–422(15 Jan 1973).

Spectroscopic observations are presented showing the presence of emitting clouds in the inner regions of Markarian 78. These clouds are similar to the "nuclear clouds" found by Walker in the Seyfert galaxies NGC 1068 and NGC 4151. Interference-filter photographs are also presented showing Markarian 78 to be enveloped in a network of filaments similar to those seen in "exploding" galaxies. An attempt is made to understand the outlying filaments as remnants of a previous explosion ionized by nonthermal radiation from the nucleus. (auth)

15595 TIDAL ORIGIN OF ELLIPTICAL GALAXIES OF HIGH SURFACE BRIGHTNESS. Faber, S. M. (Univ. of California, Santa Cruz). Astrophys. J.; 179: No. 2, 423–426(15 Jan 1973).

Three peculiar elliptical galaxies having high surface brightness

and low luminosity are discussed. Several lines of evidence indicate that they are the tightly bound cores of normal elliptical galaxies whose outer regions have been stripped away in tidal interactions with more massive companions. (auth)

15596 HISTORY OF STAR FORMATION AND THE COLORS OF LATE-TYPE GALAXIES. Searle, L.; Sargent, W. L. W.; Bagnuolo, W. G. (Carnegie Institution of Washington, DC). Astrophys. J.; 179: No. 2, 427-438(15 Jan 1973).

The U, B, V colors of simple model galaxies which are characterized by three parameters were calculated: α, which specifies the mass distribution of stars at birth, β, the reciprocal decay time of an assumed exponential decay in the rate of star formation, and their age. The computations were based on theoretical evolutionary tracks for individual stars. The models for which $\beta \to \infty$ are shown to give a satisfactory account of the observed integrated colors of open clusters as a function of age. The observed colors of Sc and Irr I galaxies were found to be consistent with the following ideas. (a) All galaxies are approximately 10^{10} years old. (b) An initial luminosity function qualitatively similar to the Salpeter function obtains in all late-type galaxies, but irregulars are somewhat more enriched in massive stars than Sc's are. (c) The mean rate of star formation, averaged over sufficiently large regions of a galaxy and over sufficiently long times, is a declining function of time. (d) Different galaxies of the same morphological type have very different decay times for star formation, and many galaxies have experienced roughly uniform rates of star formation for the last 10^{10} years. It is proposed that the range in colors of the late-type galaxies reflects this range in decay times and if so, the frequency of Type II supernovae will depend on both the mass and the color of the parent galaxy. The question is discussed whether the bluest known galaxies, all of which are dwarfs, are young. It is tentatively concluded that, instead, they are galaxies which undergo intermittent and unusually intense bursts of star formation. (auth)

15597 NEUTRAL HYDROGEN AT TWO HOLMBERG RADII FROM M33. Wright, M. C. H. (National Radio Astronomy Observatory, Charlottesville, VA). Astrophys. J.; 179: No. 2, 453-460(15 Jan 1973).

Neutral hydrogen emission was detected at two Holmberg radii from M33 in the region of a continuum radio source 4C 29.3. Interferometric measurements showed that there was no absorption to an rms limit of 3% of the flux of the source. If the gas is in front of the source, it is optically thin with a surface density of $3.3 \cdot 10^{19}$ cm^{-2} and a spin temperature $T_s > 9$°K (3 × rms value). The emission is probably an extension of the H I in the plane of M33. (auth)

15598 KINEMATIC PROPERTIES OF 30 H II REGIONS IN THE SMALL MAGELLANIC CLOUD. Smith, M. G. (Cerro Tololo Inter-American Observatory, La Serena, Chile); Weedman, D. W. Astrophys. J.; 179: No. 2, 461-467(15 Jan 1973).

Emission-line profiles and radial velocities for 30 H II regions in the Small Magellanic Cloud were observed with a pressure-scanned Fabry–Perot interferometer having a spectral resolution of 11 km s^{-1}. The most probable velocities of internal gas motions varied little among the H II regions and averaged 14.2 km s^{-1}. Radial velocities accurate to 2.5 km s^{-1} showed a steep velocity gradient across the SMC but did not prove that the SMC is rotating. (auth)

15599 PRESSURE EQUILIBRIUM OF FINITE-SIZE CLOUDS IN THE INTERSTELLAR MEDIUM. Graham, R.; Langer, W. D. (New York Univ., NY). Astrophys. J.; 179: No. 2, 469-481 (15 Jan 1973).

The pressure equilibrium between the cloud and the intercloud medium was considered for clouds of finite size. Whereas the balance between the cosmic-ray heating and the cooling of the interstellar medium explains the coexistence of cloud and intercloud medium, surface effects due to heat conduction play a role in determining the cloud sizes. In general it was found that a mass flow exists across the cloud–intercloud interface and that, for small clouds, this mass flow becomes an important part of the dynamics. For clouds $\lesssim 5 \times 10^{16}$ cm (depending on pressure) the evaporation rate is large and the cloud lifetime is short ($\lesssim 10^7$ years). (auth)

15600 SPECTRA OF THE BECKLIN–NEUGEBAUER POINT SOURCE AND THE KLEINMANN–LOW NEBULA FROM 2.8 TO 13.5 MICRONS. Gillett, F. C.; Forrest, W. J. (Univ. of California, San Diego). Astrophys. J.; 179: No. 2, 483-491(15 Jan 1973).

Spectra of the Becklin–Neugebauer point source and the Kleinmann–Low nebula complex were obtained from 2.8 to 13.5 μ with $\Delta\lambda/\lambda \sim 0.01$ to 0.02. The spectrum of the point source showed strong absorption features at 3.1 and 10 μ. The feature at 3.1 μ corresponded well to that expected from 10^{-4} g cm^{-2} of H_2O ice grains. The 10-μ absorption feature was similar in shape to the excess emission observed from several M stars and requires about 3 to 4×10^{-4} g cm^{-2} of silicate material to reproduce the depth of this feature. The Kleinmann–Low nebula also showed evidence of a strong absorption at 10 μ, possibly much stronger than that seen against the point source. (auth)

15601 LOW-INTENSITY BALMER EMISSIONS FROM THE INTERSTELLAR MEDIUM AND GEOCORONA. Reynolds, R. J. (Goddard Space Flight Center, Greenbelt, MD); Roesler, F. L.; Scherb, F. Astrophys. J.; 179: No. 2, 651-657(15 Jan 1973).

Galactic and nongalactic components of the diffuse Hα and Hβ nightsky emissions were resolved with a Fabry–Perot spectrometer. The nongalactic component of both lines accounts for most of the emission at galactic latitudes greater than 30° The intensities of the galactic component yield values for the average ionization rate per hydrogen atom that are between 10^{-15} and 10^{-14} s^{-1} assuming steady-state ionization. (auth)

15602 FRANCK–CONDON FACTORS FOR THE CH^+ A $^1\Pi - X\ ^1\Sigma^+$ TRANSITION. Green, S. (Goddard Inst. for Space Studies, New York); Hornstein, S.; Bender, C. F. Astrophys. J.; 179: No. 2, 671-673(15 Jan 1973).

Accurate ab initio potential energy curves were used to calculate the vibrational eigenvalues and eigenfunctions for the A $^1\Pi$ and X $^1\Sigma^+$ electronic states of CH^+. The calculated Franck–Condon factors were $q(0,0) = 0.665$ and $q(1,0) = 0.249$. These were in moderately good agreement with earlier values based on Morse potentials, but they differed markedly from recent values based on Rydberg–Klein–Rees potentials. (auth)

15603 DIAMETERS OF H II REGIONS IN M31 AND COMPARISON WITH THE LARGEST REGIONS IN M33. Arp, H.; Brueckel, F. (Carnegie Institution of Washington, DC). Astrophys. J.; 179: No. 2, 445-451(15 Jan 1973).

In order to obtain diameters of H II regions which are comparable to those that are measured in more distant Sb spirals, small-scale plates in Hα wavelengths were obtained for M31. It was found that H II regions with low and medium surface brightness mostly ranged from less than 7 to about 40 arc sec in diameter at the distance of M31. High-surface-brightness H II regions showed a wider distribution of sizes, ranging from less than 7 to about 70 arc sec in apparent diameter. Two features in M31 appeared to be an agglomeration of smaller H II regions into single large emission regions of 150 and 180 arc sec, respectively. Observations carried out with exactly the same plate-filter and exposure combinations on M33 showed differences in the structure of the average H II region in M31 and M33. The M33 emission regions tended to be single large loops and rings. The M31 emission regions tended to be more stellar and occurred in associated groups. If the larger H II complexes in M31 were classed as single regions, then there was a contradiction to the generally quoted result that H II regions are larger in Sc than in Sb galaxies. Because of the gradual way in which the intrinsic diameter-number plot falls off toward large diameters, the apparent size of H II regions is not a very precise indicator of extragalactic distances. The results on M31 and M33 support the idea that the intrinsic sizes of H II regions are reliable as gross indicators of distance, accurate within approximately a factor of 2. (auth)

15604 STABILITY OF CERTAIN MODEL BINARY STELLAR SYSTEMS IN GALACTIC GRAVITATIONAL FIELDS. Innanan, K. A.; Wright, A. E.; House, F. C.; Keenan, D. (York Univ., Toronto). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 249-253 (1972).

It is argued using both a modified Roche criterion due to King (Astr. J.; 67: 471 (1962)) and direct numerical orbit integration that a binary star cluster cannot survive an appreciable proportion of a revolution about a point mass or spheroidal mass distribution of the proportions of the Galaxy. However, various low-density objects, such as NGC 55, and perhaps the Magellanic Clouds, deserve a more careful examination for possible binary cluster attendants. Preliminary experiments also indicate that binary systems equivalent to the Magellanic Clouds in motion about the Galaxy or NGC 185 and NGC 147 in motion around M31 can survive as binaries for much smaller perigalactic distances than predicted by King's formula if their sense of rotation is opposite to the sense of the binary's revolution about the primary. Repeated perigalactic passages may allow the Coriolis acceleration to selectively "prune" stars from some globular clusters, thereby producing an apparent mean rotation in the cluster with no primordial basis. (auth)

15605 NEW SOLUTION TO THE ACCRETION PROBLEM. Lyttleton, R. A. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 255-270(1972).

The Bondi–Hoyle theory of line-accretion is briefly reviewed, and it is shown that there are an infinity of steady-state solutions satisfying the requirements originally imposed as boundary conditions. Questions are raised as to the applicability of these solutions to physical reality. The existence is demonstrated of an entirely different type of steady-state solution that implies slow velocity in the accretion-stream beyond the neutral point. Accurate numerical values are obtained of this solution for a number of cases. The braking-action given by this solution, for any selected cut-off distance, is far stronger than on the Bondi–Hoyle solution. Consideration of the physical state in the accretion-stream shows that for this slow-solution the appropriate cut-off range would be only of the order of 10^2 AU rather than interstellar-distance order. With stronger braking-action, the velocity of stars relative to interstellar material will be reduced in correspondingly shorter times, and more rapid accretion than on the Bondi–Hoyle theory will thereby come about. This result combined with recent measures of gas densities at various regions of the Galaxy suggests that the problem posed by the brightest stars may well be resolvable on the basis of the accretion process. (auth)

15606 POSSIBLE INTERSTELLAR GALACTIC CHROMOSPHERE. Sciama, D. W. (Oxford Univ.). Nature (London); 240: No. 5382, 456-457(22 Dec 1972).

It is suggested that the disk of the Galaxy is surrounded by a shell of gas at a temperature intermediate between the 10^2 to 10^4K of the disk and the 10^6K of the corona, and that this "chromosphere" may be detectable; this suggestion is related to the hypothesis that the Galaxy is accreting hot gas from the intergalactic space of the Local Group. An accretion rate of ~3 $M_\odot$ per year is deduced, which is compatible with dynamical considerations concerning the motion of interstellar gas in the disk of the Galaxy, the age of the Galaxy, the present density of this gas, and estimates of the rate of star formation. Thermal consequences of the accretion hypothesis are also discussed, with particular reference to cooling processes. Consideration is also given as to whether the radiative flux from the galactic chromosphere would have observable consequences; this flux would consist predominantly of line radiation from heavy elements in various stages of ionization and is appreciable. It may also be possible to detect far uv lines. The proposed radiative flux of $\sim 1.5 \times 10^{-5}$ erg/cm^2/sec. may have important ionization effects in the Galaxy. The possibility is mentioned that it is the inflowing material that is responsible for the confinement of the interstellar magnetic field and cosmic rays to the disk of the Galaxy. (UK)

15607 SOME COMMENTS ON THE RECOMBINATION LINE EMISSION FROM THE GALACTIC RIDGE. Gottesman, S. T. (Univ. of Florida, Gainesville); Gordon, M. A.; Davies, R. D.; Pedlar, A.; Matthews, H. E. Nature (London) Phys. Sci.; 240: No. 103, 160-161(18 Dec 1972).

Comments are offered on the communication by Davies (Nature Phys. Sci. 238: 101 (1972)), reporting observations of radio recombination lines from regions of the galactic plane free from discrete radio sources. These comments are principally concerned with the analytical procedure adopted, and with possible difficulties in assumptions underlying the conclusion that the lines are generated by a gas of electron temperature 6200K; it is suggested that the temperature of the line-emitting gas might be quite uncertain, and that the estimate of 6200K may well be a substantial overestimate. A reply by Davies is appended. (UK)

15608 COLLISION STRENGTHS FOR THE 10.5 μ TRANSITION OF S^{3+}. Brocklehurst, M. (University Coll., London). Mon. Notic. Roy. Astron. Soc.; 160: No. 3, 19P-21P(1972).

In many gaseous nebulae, the observed intensities of the infrared transition of S^{3+} differ widely from the predicted values. A re-evaluation of the collision strengths using distorted-wave and close-coupling techniques is in reasonable agreement with previous estimates. (auth)

15609 PROBLEM OF THE STABILITY OF CLUSTERS OF GALAXIES. Karpowicz, M. (Univ., Warsaw). Postepy Astron.; 20: No. 4, 297-305(Dec 1972). (In Polish).

A number of attempts made during the last eighteen years at solution of the problem of the stability of clusters of galaxies are considered. Two important approaches to it, the hypothesis of expansion and the assumption of the presence of invisible intergalactic matter, are shown to involve serious difficulties of an observational and theoretical nature. (auth)

15610 SPIRAL STRUCTURE OF THE GALAXY. Balazs, Bela (Eoetvoes Lorand Univ., Budapest). Fiz. Szemle; 22: No. 12, 373-377(Dec 1972). (In Hungarian).

The kinematic problems arising in the spiral formations of stars and interstellar gas nebulae are examined. Correlations were established between the intensity of absorption and emission radio-frequency lines and the density of interstellar dust. Determination of the 21-cm radiation of hydrogen gas associated with cosmic dust nebulae or other molecules made it possible to measure the irradial velocity and to obtain important kinematic data. The grand design of the Galaxy is also examined, reviewing the determination of the intensity distribution of the radio-frequency continuum created by the synchrotron mechanism and of the line-structured radiation which corresponds to transitions between main quantum numbers related to recombinations from the HII areas. The theory of the spiral structure is outlined on the basis of the Lin-type gravitational density wave, indicating the role of Linblad resonances and the effect of local gravitational collapses. The Lin theory exerts a strong effect on contemporary stellar cosmogony. The spiral branches are outstanding because more energy is released in them than in the faint areas of the Galaxy. The brilliance is due to the intensive light of young objects, the birth and position of which is controlled by the stationary perturbations in the gravitational field of dwarf stars which create the "gray mass." (Review article). (TTT)

Cosmology

Refer also to abstract 15546.

15611 (AD-747505) COSMOLOGICAL MODELS WITH WEAKLY TURBULENT FLUCTUATIONS OF THE METRIC SUPERIMPOSED ON A HOMOGENEOUS AND ISOTROPIC BACKGROUND METRIC. Jackson, J. P. (Naval Postgraduate School, Monterey, Calif.). Jun 1972. 146p. NTIS.

Thesis.

Uniform and isotropic mathematical models of the expanding Universe usually predict an initial singularity of infinite mass density and space curvature. To study possible mechanisms which would avoid the occurrence of these singularities, nonuniform cosmological models based on Einstein's field equations are investigated in which random perturbations of long wavelengths are superimposed on the Robinson–Walker metric of the unperturbed models. Techniques of fluid turbulence theory, used to describe random fields by a hierarchy of central moments of the random perturbations, are applied to describe the dynamics of these moments. For the case of small perturbations the hierarchy is truncated and solutions are found. (auth)

15612 SOME REMARKS CONCERNING THE RESPONSE OF MACROSCOPIC SYSTEMS TO GRAVITATIONAL RADIATION. Weinstein, M. (New York Univ., NY). Phys. Rev., D; 6: No. 12, 3383-3389(15 Dec 1972).

Since Weber first reported the apparent detection of gravitational radiation there has been considerable discussion of how gravitational detectors work. An alternative approach to the problem is presented which emphasizes the important point that the design and calibration of such detectors can be done without reference to a theoretical understanding of the complicated systems involved. It is also shown how, with simple assumptions, one can relate the treatment to previous work. (auth)

15613 QUASARS AS EVENTS IN THE NUCLEI OF GALAXIES: THE EVIDENCE FROM DIRECT PHOTOGRAPHS. Kristian, J. (Carnegie Institution of Washington, DC). Astrophys. J.; 179: No. 2, L61-L65(15 Jan 1973).

Similarities between quasars and the nuclei of N galaxies and Seyfert galaxies suggest that quasars may also occur in galaxy nuclei. 200-inch direct photographs of quasars are consistent with this hypothesis. Those quasars which are predicted to show underlying galaxies do not. (auth)

15614 BIG-BANG NUCLEOSYNTHESIS REVISITED. Wagoner, R. V. (Cornell Univ., Ithaca, NY). Astrophys. J.; 179: No. 2, 343-360(15 Jan 1973).

The results of an improved calculation of the synthesis of elements during the high-temperature phase of the expansion of big-bang universes are presented. Adoption of the viewpoint (supported by recent evidence) that most of the observed deuterium and helium is of pregalactic origin allows very general constraints to be put on any cosmological model for their production. In fact, most models which differ appreciably from that of the most naive (standard) big-bang are ruled out. Those standard big-bang models in which the present baryon density is (1 to 3) $\times 10^{-31}$ g cm^{-3} agree best with the probable pregalactic abundances of ^{2}H, ^{3}He, and ^{4}He, if the galactic production of ^{3}He is also assumed negligible. It is also shown on very general grounds that the present universal baryon density and average abundance (by mass) of primordial deuterium should be related by $\langle \rho_b (T = 2.7^\circ K) \rangle \langle X(^2H) \rangle \leq 2 \times 10^{-34}$ g cm^{-3}. Since no known galactic process can produce a deuterium abundance of $X(^2H) > 10^{-6}$, any detection of interstellar deuterium in this range could be of profound cosmological significance. (auth)

15615 ORIGIN OF THE MICROWAVE BACKGROUND. Layzer, D.; Hively, R. (Harvard Univ., Cambridge, MA). Astrophys. J.; 179: No. 2, 361-369(15 Jan 1973).

An alternative to the conventional interpretation of the cosmic microwave background as the remnant of a primordial fireball is explored. It is postulated that the radiation was generated by ordinary astronomical processes (thermonuclear reactions in stars or gravitational collapse of objects of galactic mass) and subsequently thermalized by interaction with dust grains. The observed properties of the radiation (temperature, thermal spectrum, and isotropy) impose severe constraints on any theory of this general character, all of which can be met if most of the matter in the early Universe condensed into stars in the mass range 5 to 10 $M_{\odot}$. These stars would have released most of their energy at redshifts $25 \lesssim z \lesssim 50$. Subsequently, during the explosive phase of their evolution, they would have ejected the heavy elements from which the grains required to thermalize the radiation could have formed. The assumption that most of the matter in the Universe was once bound in such stars fits naturally into a previously described cosmogonical theory based on the assumption of a zero-temperature initial state. Radiation from collapsing objects of galactic mass could also have contributed to the microwave background, but is unlikely to be the main energy source unless the grains responsible for thermalization were formed from heavy elements created in the initial stages of the expansion and had unusually high radiative efficiency at centimeter wavelengths. The grains responsible for thermalizing the microwave background affect the magnitudes and colors of distant galaxies and quasars. For galaxies with redshifts $z < 0.3$, the predicted extinctions are small enough to have escaped detection. At larger redshifts, however, the extinction increases steeply with increasing z, reaching 4 mag at $z = 3$ and 6 mag at $z = 4$. If the grains have lifetimes of order 10^9 years, then still larger extinctions at redshifts $z \simeq 2$ would be compatible with the galaxy data. This suggests that the failure to observe quasars with redshifts $z \gtrsim 3$ may be due not to a real thinning out of these objects, but to extinction by the grains responsible for thermalizing the microwave background. (auth)

15616 COMMENT ON THE NOERDLINGER HYPOTHESIS. Hill, J. K. (Univ. of California, Berkeley). Astrophys. J.; 179: No. 2, 371-373(15 Jan 1973).

Diffuse x-radiation resulting from intergalactic gas in clusters of galaxies is computed, on the assumption that all galaxies originally formed as members of compact clusters which contained enough gas to bind them gravitationally. This hypothesis is shown to be untenable if thermal energy is transferred to the gas in order to expand or dissolve the clusters. (auth)

15617 PRIMORDIAL IRREGULARITIES IN THE EARLY UNIVERSE. Tomita, K. (Hiroshima Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1503-1516(Nov 1972).

In the early universe, there is an "anti-Newtonian stage" when the dimension of an irregularity exceeds the horizon ct, far before the decoupling epoch. In this paper the evolution of an irregularity at this stage is clarified, in which general relativistic non-linearity plays an essential role. It is concluded that the explosion time (or the singular point) of the irregularity depends sensitively on the energy density within it (e.g., the rotational energy density), that the existence of primordial random motions at the later stage leads necessarily to the concept of a "space-time-curvature turbulence" at an extremely early stage when random explosions are raised and that the irregularity in the neighborhood of its singular point is considerably anisotropic. The significance of these conclusions in the formation of nuclear elements at the early stage is also discussed. (auth)

15618 RADIO SOURCE COUNTS AND REDSHIFTS IN STEADY STATE COSMOLOGY. Schmidt, M. (Carnegie Institution of Washington, Pasadena, CA). Nature (London); 240: No. 5381, 399-400(15 Dec 1972).

It is stated that there appears to be continuing confusion as to whether counts of extragalactic radio sources are compatible with the steady state theory. The present author gives an explicit derivation of source counts expected in the steady state on the basis of identifications and red shifts of a complete sample of radio galaxies and QSOs. The method employed has the advantage that the properties of the individual sources in the sample, such as the spectral index or even curved radio spectra are included in the derived source counts. There is no doubt about the cosmological origin of the red shifts of the radio galaxies, but the situation is different for the QSOs, and the steady state can accommodate the QSOs only if their red shifts are mostly non-cosmological. The expected total source counts, compared to the observed source counts, are shown graphically; the disagreement is very large. It is concluded that whatever is the interpretation of QSO red shifts, the observed radio source counts, identifications and red shifts are incompatible with steady state cosmology. (UK)

15619 PROCESS OF EXPLOSION DECAY AND SIMULTANEOUS COLLISIONS OF n MATERIAL GRAVITATING POINTS. Nezhinskii, E. M. (Inst. of Theoretical Astronomy, Leningrad). Dokl. Akad. Nauk SSSR; 206: No. 3, 566-567(21 Sep 1972). (In Russian).

A cosmo-mechanical study was made of the type of explosions which may occur in the nuclei of galaxies or other centers of condensed material. The post-explosion flying about of n material points which exert only gravitational forces on each other was considered. The problem concerning the stability of the resulting configuration in one case resolved itself into the determination of the signs of the characteristic numbers of a given matrix. (KSW)

15620 REDSHIFT MAGNITUDE RELATION FOR RADIATION UNIVERSES. Kaufman, S. E. (New York Univ., NY). Nuovo Cim.; 13B: No. 1, 91-100(11 Jan 1973).

A closed formula for the relation between distance and redshift in an expanding radiation-filled universe is derived for the case of positive cosmological constant and positive space curvature. This formula is then generalized so that it is valid for all values of the cosmological constant and the three possible space curvatures. From this distance–redshift formula, a generalized redshift–magnitude relation is found. This latter formula is then checked by testing it with the cases expressible in terms of elementary functions. (auth)

15621 HIGH-FREQUENCY SOUND WAVES TO ELIMINATE A HORIZON IN THE MIXMASTER UNIVERSE. Chitre, D. M. (Univ. of Utah, Salt Lake City). Phys. Rev., D; 6: No. 12, 3390-3396(15 Dec 1972).

From the linear wave equation for small-amplitude sound waves in a curved space–time, there is derived a geodesiclike differential equation for sound rays to describe the motion of wave packets. These equations are applied in the generic, nonrotating, homogeneous closed-model universe (the "mixmaster universe," Bianchi Type IX). As for light rays described by Doroshkevich and Novikov (DN), these sound rays can circumnavigate the Universe near the singularity to remove particle horizons only for a small class of these models and in special directions. Although these results parallel those of DN, different Hamiltonian methods are used for treating the Einstein equations. (auth)

15622 RELATIVISTICAL ASTROPHYSICS. I. Demianski, M. (Univ., Warsaw). Postepy Astron.; 20: No. 4, 307-327(Dec 1972). (In Polish).

A description of the external gravitational field of relativistic astrophysical objects is given. (auth)

15623 RELATIVISTICAL ASTROPHYSICS. II. Demianski, M. (Univ., Warsaw). Postepy Astron.; 20: No. 4, 329-350(Dec 1972). (In Polish).

Hydrodynamic equations are stated and discussed. Relativistic shock waves are described. (auth)

Planetary Phenomena

Refer also to abstract 15721.

15624 (N-72-26578) ^{252}Cf NEUTRON CAPTURE AND DECAY METHODS FOR ELEMENTAL ANALYSIS. Final Report. (Geological Survey, Washington, D. C.). 25 Apr 1972. 32p. (NASA-CR-127119). NTIS.

The feasibility of using a ^{252}Cf neutron source in conjunction with a capture and/or decay gamma-ray method for elemental analysis on lunar or planetary missions was tested. The general problems of using a ^{252}Cf neutron source for both decay and capture gamma-ray analysis in terrestrial environments included the determination of the capture gamma-ray spectra by neutron absorption in various metals used for the space hardware, ^{252}Cf source encapsulation materials, shielding, geometry, and optimum source size for a space mission. Computer data reduction and data transmission techniques were also investigated. (auth)

15625 TERRESTRIAL HEAT FLOW, THE NEUTRINO PROBLEM, AND A POSSIBLE ENERGY SOURCE IN THE CORE. Hamza, V. M.; Beck, A. E. (Univ. of Western Ontario, London). Nature (London); 240: No. 5380, 343-344(8 Dec 1972).

It is stated that borehole measurements have shown a variation of terrestrial heat flow with depth, and in a study of the origin of these variations a detailed profile was obtained of the U, Th, and K concentrations in the rocks through which the borehole passed, in order to estimate heat production values. A similarity between

the heat flow and heat production profiles was found, but the magnitude of the heat production variations was insufficient to explain the magnitude of the heat flow variations. In addition to experimental errors a possible source of error could lie in the heat production constants used, and using the most up-to-date data available the constants were recalculated for the radioactive elements that might make a significant contribution to the observed heat flow; these include ^{40}K, ^{87}Rb, ^{232}Th, and ^{238}U with ^{235}U and possibly ^{147}Sm as borderline cases. Two independent methods were used for the calculations, the results of which are tabulated. It is assumed that two-thirds of the β-decay energy escapes from the Earth as neutrino and antineutrino energy, the remaining energy being absorbed near the production site. Recently, however, doubt has been cast on the assumption that the neutrino is necessarily stable; and it has been suggested that although the neutrino is stable over path lengths of the order of 10^4 cm it may be unstable over greater path lengths. The implications of this for heat production and heat flow are discussed, and data are given for heat production for the significant radioactive elements with and without the neutrino energy. If the neutrino is an unstable particle there is a distinct possibility that some of the thermal energy in the Earth's core and mantle originates from radionuclides in the crust. A much more accurate estimate of the stable path length of neutrinos is required. (UK)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 15483, 15487, 15561, 15562, 15582, 15681, 15698, 15708, 16119, and 16392.

15626 (AD-746060) GENERALIZED SLAB MODEL AND FINITE LARMOR RADIUS EFFECTS. Semiannual Technical Report, September 15, 1971–March 14, 1972. Shiau, J.-N.; Simon, Albert (Rochester Univ., N. Y.). Apr 1972. Contract F30602-70-C-0001. 24p. (RADC-TR-72-147). NTIS.

An equilibrium slab model of a barium cloud is derived. This model has finite length in the magnetic-field direction and allows one to study the stability of configurations with various degrees of ionospheric short-circuiting. It reduces to previous models for the case of no short-circuiting but is quite different in the more general case. The combined influence of finite Larmor radius corrections and inertia on the stability of the infinite slab model is studied. A simple dispersion relation is obtained. (auth)

15627 (AD-746283) PHENOMENOLOGY OF ARCTIC PARTICLE PRECIPITATION. Final Report, March 1, 1969–February 28, 1972. Akasofu, S.-I. (Alaska Univ., College. Geophysical Inst.). May 1972. Contract F19628-69-C-0182. 10p. (AFCRL-72-330). NTIS.

Results of the projects that were carried out in assisting the airborne operation of the AFCRL Flying Laboratory are briefly described. Analyses were made of all-sky photographs and some ionograms taken during the flights and ground magnetic records from auroral zone stations for all the flight periods, and have confirmed the existence of a circumpolar oval band of auroras, the auroral oval, and the associated ionospheric structure during both quiet and disturbed periods (substorm periods). (auth)

15628 (AD-747027) ANALYSIS OF SIMULTANEOUS POLAR FOX II BACKSCATTER AND IONOSPHERIC SOUNDING DATA. Gassmann, G. J.; Buchau, J. (Air Force Cambridge Research Labs., L. G. Hanscom Field, Mass.). 3 May 1972. 15p. (AFCRL-72-432). NTIS.

Backscatter data from the northward-looking POLAR FOX II radar were simultaneously taken with airborne and ground-based ionospheric soundings and optical data supplemented by satellite observations. The detailed ionization contour lines in the region from 0 to 2000 km north of POLAR FOX II, obtained for a period of about 2 hours before local midnight in December, explain why only a small-range section of ground could be seen during this period. Aspect-sensitive direct backscatter echoes from field-aligned laminae, both in the E and F layer, were dominant and were found to be reflected from latitudes where vertical soundings show spread E and F. Those regions appear to be identical to the auroral E (night E) layer and plasma-ring F layer known to be associated with the auroral oval. (auth)

15629 (AD-747034) THEORETICAL SOLAR TERRESTRIAL PLASMA PHYSICS. Final Report, October 19, 1970–October 15, 1971. Kalman, Gabor; Bakshi, Pradip (Boston Univ., Mass. Dept. of Physics). Oct 1971. Contract F19628-71-C-0078. 22p. (AFCRL-71-621). NTIS.

A nonlinear fluctuation–dissipation theorem relating quadratic plasma response functions to ternary equilibrium correlations was derived. Large-amplitude nonlinear waves in a magnetized plasma with and without collisions were studied. A computer code for the calculation of the synchrotron–Cherenkov radiation by high-energy electrons in a cold plasma was developed, and detailed numerical results were obtained. A critical review of solar-flare phenomena with a suggestion for the prevailing dynamical processes leading to the acceleration of particles to high energies is presented. (auth)

15630 (AD-747244) LOW-ENERGY ELECTRON IMPACT RATE COEFFICIENTS FOR SOME ATMOSPHERIC SPECIES. Ali, A. W.; Anderson, A. D. (Naval Research Lab., Washington, D. C.). 27 Jun 1972. 49p. (NRL-7432). NTIS.

Low-energy electron impact excitation and ionization rate coefficients, relevant to ionospheric species, are calculated using measured or calculated cross sections. (auth)

15631 (AD-747495) DOUBLE RESONANCE PRODUCTION OF IONOSPHERIC IRREGULARITIES. Final Report, May 1, 1971–June 30, 1972. Arnush, Donald; Fried, B. D.; Kennel, C. F.; Margulies, R. S.; Wong, A. Y. (TRW Systems Group, Redondo Beach, Calif.). 30 Jun 1972. Contract F44620-71-C-0075. 78p. (AFOSR-TR-72-1289). NTIS.

A central question is the anomalously broad spectral width of the plasma line observed during ionospheric rf heating at Arecibo. The authors first suggested this is due to lower hybrid parametric instabilities but rejected it due to its high-power threshold. They developed a numerical code that traces propagation and amplification of electron waves generated by ion acoustic parametric instability in a vertically stratified ionosphere. It is found that the plasma line observed by backscatter has a "core" of locally generated and detected waves, and broad "wings" of remotely generated high-frequency waves. The wings are highly aspect and frequency sensitive. The authors also suggest that an intense rf pump should trap plasma waves in its field maxima, which may account for the fading observed in Boulder rf heating experiments. (auth)

15632 (N-72-25329) DIFFERENTIAL PHASE MEASUREMENTS OF D-REGION PARTIAL REFLECTIONS. Wiersma, D. J.; Sechrist, C. F. Jr. (Illinois Univ., Urbana. Aeronomy Lab.). 1 Mar 1972. 79p. (NASA-CR-126725; UILU-ENG-72-2502). NTIS.

Differential-phase partial-reflection measurements were used to deduce D-region electron-density profiles. The phase difference was measured by taking sums and differences of amplitudes received on an array of crossed dipoles. The reflection model used was derived from Fresnel reflection theory. Seven profiles obtained over the period from October 13, 1971 to November 5, 1971 are presented, along with the results from simultaneous measurements of differential absorption. Some possible sources of error and error propagation are discussed. A collision-frequency profile was deduced from the electron concentration calculated from differential phase and differential absorption. (auth)

15633 (N-72-25341) METALLIC IONS IN THE EQUATORIAL IONOSPHERE. Aikin, A. C.; Goldberg, R. A. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1972. 43p. (NASA-TM-X-65891; X-625-72-129). NTIS.

Four positive ion composition measurements of the equatorial E region made at Thumba, India, are presented. During the day, the major ions between 90 and 125 km are NO^+ and O_2^+. A metallic ion layer centered at 92 km is observed, and found to contain Mg^+, Fe^+, Ca^+, K^+, Al^+, and Na^+ ions. The layer is explained in terms of a similarly shaped latitude distribution of neutral atoms which are photoionized and charge-exchanged with NO^+ and O_2^+. Three-body reactions form molecular metallic ions that are rapidly lost by dissociative ion–electron recombination. Nighttime observations show downward drifting of the metallic ion layer caused by equatorial dynamo effects. These ions react and form neutral metals which exchange charges with NO^+ and O_2^+ to produce an observed depletion of those ions within the metallic ion region. (auth)

15634 (N-72-25756) RADIO WAVE PROPAGATION EXPERIMENTS TO PROBE THE IONOSPHERE. Schmid, P. E. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). 1972. 7p. NTIS.

Ionospheric bias corrections associated with radio tracking of spacecraft depend on the following measuring techniques for integrated electron content: (1) Faraday rotation measurements from an Earth synchronous satellite; (2) ranging measurements at two frequencies; and (3) group- and phase-velocity measurements obtained from tracking data. The extraction of the integrated electron content directly from tracking data is achieved by comparison of range-rate measurements based on Doppler shift with differentiated range measurements based on tone delay. This method is most desirable because the measured corrections pertain directly to the spacecraft whose orbit is being determined and can be used in near-Earth as well as deep space tracking data. (STAR)

15635 (N-72-26310) IONOSPHERE TOTAL ELECTRON MEASUREMENTS AS EXTRACTED FROM SATELLITE TRACKING DATA. Murray, C. W. Jr.; Schmid, P. E.; Rangaswamy, S. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). 21 Jun 1972. 19p. (NASA-TM-X-65911; X-551-71-475). NTIS.

The Goddard Range and Range Rate System (GRARR) determines the range of a spacecraft by measuring the group delay of a modulated wave and the range rate by measuring the Doppler phase shift of the carrier. An analytical technique is presented for obtaining corrections and equivalent total electron content along the vertical, using vhf GRARR data and a radial model of the ionosphere. Results of computation for a representative pass are given, and esti-

mated accuracy is discussed from a statistical viewpoint, using vhf GRARR data and a radial model of the ionosphere. Using GRARR range, range rate, and angle tracking data from Explorer 41, values of total electron content on the order of 10^{17} to 10^{18} (electrons/m^2) were obtained. These values agree with estimates of the total electron content from ionospheric profiles using f_0F2 predicted data. (auth)

15636 (N-72-27357) WORLD MAPS OF PREDICTED ELECTRON INTENSITIES FOR THE ITOS-A/NOAA-1 SPACECRAFT. Stassinopoulos, E. G. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jun 1972. 14p. (NASA-TM-X-65917). NTIS.

Maps of electron fluxes >10,000, >1 million, and >10 million particles/cm^2/sec are presented for an ITOS-A/NOAA-1 circular orbit, inclination of 79° and altitude of 1463 km. The uncertainty in the flux values is about a factor of 3, and the error in contour plotting may be ±2° in latitude and ±3° in longitude. The fractional lifetime spent within the different intensity regions is graphed. (STAR)

15637 OBSERVATIONS OF INTERCHANGE BETWEEN ACCELERATION AND THERMALIZATION PROCESSES IN AURORAL ELECTRONS. Pongratz, M. B. College Park, MD; Univ. of Maryland (1972). 275p. University Microfilms Order No. 72-29,416.

Thesis.

The results of high time-resolution measurements of energetic electrons in an auroral breakup are presented. Electrons with energies from 500 eV to over 100 keV and pitch angles from 0 to 150° were detected with two detectors onboard sounding rocket 18:63 UE. (TSS) (Diss. Abstr. Int., B)

15638 CHERENKOV RADIATION FROM MAGNETOPLASMA. Agarwal, D. C. (Univ. of Allahabad, India). Indian J. Phys.; 46: No. 4, 177-82(Apr 1972).

Cherenkov radiation processes in the Earth's ionosphere are calculated. The calculations are made for frequencies radiated in vlf and elf bands at midlatitudes during normal days. The calculation shows that the presence of positive ions in the ionosphere reduces the radiated power in the elf band, while it has no effect in the upper end of the vlf region. (auth)

15639 MEASURED ANISOTROPY IN THE IONOSPHERIC ELECTRON TEMPERATURE. Clark, D. H.; Raitt, W. J.; Willmore, A. P. (University Coll., London). J. Atmos. Terrest. Phys.; 35: No. 1, 63-76(Jan 1973).

The two-plane ac Langmuir probes of ESRO-1A have measured topside electron temperatures parallel and perpendicular to the geomagnetic field, which often differ appreciably. These temperature differences are interpreted as a real anisotropy in the energy distribution of the thermal electrons. Possible causative mechanisms are discussed. The results refer to a 6-month period centered on northern winter, and near the sunspot maximum. (auth)

15640 SOLAR CONTROL OVER THE EVOLUTION OF F2 LAYER AFTER SUNRISE. Nestorov, G. T. (Inst. of Geophysics, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 7, 913-16(1972).

A vertically continuous sounding of the F2 layer at a fixed frequency is used to determine the moment that variations occur in electron density after sunrise. The observations were begun September 1966 in the Sofia Ionospheric Observatory. An analysis is made of the temporary interval Δt after sunrise, in which the electron density in the F2 layer attains and just exceeds the level $N = 7 \times 10^5$ cm^{-3}. The interval is dependent upon the solar-activity phase, the season, the degree of geomagnetic control, the dynamic processes, and other parameters. A dependence between Δt and the relative sunspot number is found. (JCW)

15641 OBSERVATIONS OF THE He II 304-A RADIATION IN THE NIGHT SKY. Paresce, F.; Bowyer, S.; Kumar, S. (Univ. of California, Berkeley). J. Geophys. Res.; 78: No. 1, 71-79 (1 Jan 1973).

The intensity and spatial variations of the He II 304-A radiation in the night sky were measured to an altitude of 264 km from a sounding rocket launched from Thumba, India, on March 10, 1970. The data obtained are presented in the form of an all-sky map and are compared with theoretical predictions. The data are not consistent either with diffusive equilibrium models of exospheric helium or with plausible models of helium in the interplanetary medium. The data can be fit with a constant density plasmasphere model bounded at the magnetic shell L = 4 in combination with a tenuous gas of helium ions in the plasma sheet. Numerical results obtained with this model are compared with in situ satellite observations. (33 references) (auth)

15642 SEMIANNUAL VARIATION OF GEOMAGNETIC ACTIVITY. Russell, C. T.; McPherron, R. L. (Univ. of California, Los Angeles). J. Geophys. Res.; 78: No. 1, 92-108(1 Jan 1973).

The semiannual variation in geomagnetic activity is well established in geomagnetic data. Its explanation has remained elusive, however. It is proposed that it is caused by a semiannual variation in the effective southward component of the interplanetary field. The southward field arises because the interplanetary field is ordered in the solar equatorial coordinate system, whereas the interaction with the magnetosphere is controlled by a magnetospheric system. Several simple models utilizing this effective modulation of the southward component of the interplanetary field are examined. One of these closely predicts the observed phase and amplitude of the semiannual variation. This model assumes that northward interplanetary fields are noninteracting and that the interaction with southward fields is ordered in solar magnetospheric coordinates. The prediction of the diurnal variation of the strength of the interaction at the magnetopause by this model, does not, however, match the dirunal variation of geomagnetic activity as derived from ground-based data. However, predictions of the dependence of geomagnetic activity on the polarity of the interplanetary magnetic field and of a 22-year cycle in geomagnetic activity are confirmed by studies of ground-based data. It appears that the mechanism controlling the semiannual variation of geomagnetic activity has been identified but that a quantitative model must await further refinements in the knowledge of the solar wind-magnetosphere coupling. (27 references) (auth)

15643 COMPARISON OF T_e AND T_i FROM Ogo 6 AND FROM VARIOUS INCOHERENT SCATTER RADARS. McClure, J. P. (Univ. of Texas, Dallas); Hanson, W. B.; Nagy, A. F.; (and others). J. Geophys. Res.; 78: No. 1, 197-205(1 Jan 1973).

Langmuir probe and retarding potential analyzer (RPA) data on the electron and ion temperatures T_e and T_i obtained from Ogo 6 are compared with T_e and T_i values obtained from the incoherent scatter network. The satellite to radar temperature ratio T_{eS}/T_{eR} is 1.15 on the average for these comparisons. This discrepancy is larger than the uncertainties usually placed on the probe and radar T_e values. It is, however, a smaller discrepancy than that found in many previous comparisons of this type. The data do not appear to give any insight into the cause of the discrepancy. The ion temperature ratio T_{iS}/T_{iR} is approximately 1.0, independent of the particular radar examined. The internal accuracy of the RPA T_i data set was ±5% or better. Thus this comparison serves as an intercalibration of the incoherent scatter network. Since no significant systematic errors (i.e., errors larger than the statistical errors) exist between the RPA and radar T_i data, it appears very unlikely that any significant systematic errors exist in either data set. It should be noted, however, that the comparison data were limited to mainly nighttime hours and thus to relatively low temperatures and were heavily weighted to altitudes between 400 and 600 km, where suspected sources of systematic error are minimum. (auth)

15644 ANALYSIS OF THE PULSED-WAVE-INTERACTION EXPERIMENT. Coyne, T. N. R. (Communications Research Centre, Ottawa). J. Geophys. Res.; 78: No. 1, 206-217(1 Jan 1973).

Analytical methods used for the deduction of electron density profiles in the D region from the pulsed-wave-interaction experiment are reviewed briefly. These are found to be generally unsatisfactory, and a new analysis procedure is proposed. Its application is demonstrated by using simulated-wave interaction measurements. (22 references) (auth)

15645 SPREAD F AND IONOSPHERIC CURRENTS. Perkins, F. (Bell Telephone Labs., Whippany, NJ). J. Geophys. Res.; 78: No. 1, 218-226(1 Jan 1973).

It is shown that the widely used equilibrium in which the nighttime F region is supported by E × B drifts in unstable if, in addition to the supporting eastward field, a north-south electric field component exists. The instability, which takes the form of rising and falling sheets of ionization, has a growth rate $\gamma \approx 3 \times 10^{-4}$ ν_{in}^{-1} sec^{-1}, where ν_{in} is ion-neutral collision frequency at the F-region peak. These conclusions are based on a set of new moment equations that govern the time evolution of the Pedersen conductance and the plasma content of a flux tube. It is argued that temperate- and high-latitude spread F is a result of this instability. The new moment equations also predict: (1) that there is a maximum height-integrated Pedersen current that the F region can carry; and (2) that barium clouds deform in agreement with observations of recent releases. (22 references) (auth)

15646 INSTABILITIES IN THE EQUATORIAL ELECTROJET. Farley, D. T. (Cornell Univ., Ithaca, NY); Balsley, B. B. J. Geophys. Res.; 78: No. 1, 227-239(1 Jan 1973).

Recent radar data show that the so-called magnetic "threshold effect" has little physical significance at radar frequencies of 50 MHz or less and results simply from the way in which past data have been presented. At these frequencies, type-II irregularities give strong echoes for electron-drift velocities well below the two-stream instability threshold. At 150 MHz, however, only type-I

irregularities appear to be important, and hence there is a true threshold. Data indicate that the electrojet is highly "turbulent" over distances of hundreds of meters. It is believed that it is the local drift velocity within the large-scale irregularities that controls the excitation of instabilities on a smaller scale, and that this local velocity may differ substantially from the mean electron velocity. With this hypothesis, it is possible to account at least qualitatively for the hitherto puzzling observations that (1) type-I echoes appear nearly simultaneously over a range of elevation angles, (2) type-II and type-I echoes are observed with a vertically directed radar, and (3) the characteristic Doppler velocity of the type-I echoes is apparently always the ion-acoustic velocity, whereas theory predicts that the irregularity velocity should increase with electron-drift velocity when and if the latter exceeds the two-stream threshold. (26 references) (auth)

15647 GENERATION OF SMALL-SCALE IRREGULARITIES IN THE EQUATORIAL ELECTROJET. Sudan, R. N.; Akinrimisi, J.; Farley, D. T. (Cornell Univ., Ithaca, NY). J. Geophys. Res.; 78: No. 1, 240-248(1 Jan 1973).

A theory that accounts for the generation of short-wavelength irregularities in the equatorial electrojet for an electron drift velocity below the ion-acoustic speed is presented. Long-wavelength (tens of meters) horizontally propagating waves driven unstable by the ambient ionization density gradient are found not to steepen very much, even though they are non-dispersive. However, the local vertical velocity and horizontal density gradient associated with these waves are capable of generating the meter-wavelength obliquely propagating irregularities detected in radar observations. (29 references) (auth)

15648 IS THERE ENOUGH SOLAR EXTREME ULTRAVIOLET RADIATION TO MAINTAIN THE GLOBAL MEAN THERMOSPHERIC TEMPERATURE. Roble, R. G.; Dickinson, R. E. (National Center for Atmospheric Research, Boulder, CO). J. Geophys. Res.; 78: No. 1, 249-257(1 Jan 1973).

The global mean temperature profile of the neutral thermosphere above 120 km is calculated using the solar euv flux tabulation of H. E. Hinteregger (1970) for wavelengths less than 1310 A and the data of K. G. Widing et al., (1970) for wavelengths greater than 1310 A. With a heating efficiency of 0.33, the calculated global mean exospheric temperature is 700°K. This temperature does not lie within the range of 900 to 1050°K global mean temperature obtained from the model of L. G. Jacchia (1971) for the range of solar $F_{10.7}$ emission suggested by H. E. Hinteregger (1970) as appropriate to his data. The electron temperature in the ionosphere is also calculated using the solar euv flux and is compared with the data of J. V. Evans (1971). The calculated electron temperature is also considerably lower than the measured values. Calculations show that a doubling of the solar euv flux for wavelengths less than 1310 A is required to bring both the neutral and electron temperatures into reasonable agreement with observations. (38 references) (auth)

15649 FAR-ULTRAVIOLET SPECTRA AND ALTITUDE PROFILES OF THE DAWN AIRGLOW. Rottman, G. J.; Feldman, P. D.; Moos, H. W. (Johns Hopkins Univ., Baltimore). J. Geophys. Res.; 78: No. 1, 258-264(1 Jan 1973).

The far-ultraviolet spectrum of the dawn airglow (solar zenith angle = 86°) was observed with a scanning Ebert spectrophotometer aboard an Aerobee-170 rocket launched from White Sands, New Mexico, on January 25, 1971, at 0727 MST. Altitude profiles were obtained between 100 and 244 km for the brightest spectral features, HI λ1216, OI λ1304, and OI λ1356. The OI λ1356 column intensity is used to estimate a λ1356 intensity of ~10 R at the unilluminated magnetic conjugate point; this procedure is consistent with recent observations. The peak cross section for electron impact excitation of the $(2p^3 3s)^5S$ state of atomic oxygen is derived from a comparison of the λ1356 intensity with that of the $N_2(0,0)$ second positive band measured simultaneously. (28 references) (auth)

15650 COMPARISON OF THE CORRELATION OF INCOHERENT SCATTER AND IONOSONDE MEASUREMENTS OF TEMPERATURE WITH CALCIUM PLAGE AND 2800-MEGAHERTZ INTENSITIES. Rohrbaugh, J. L.; Swartz, W. E.; Nisbet, J. S. (Pennsylvania State Univ., University Park). J. Geophys. Res.; 78: No. 1, 281-287(1 Jan 1973).

The variation in the diurnal thermospheric neutral temperatures has been studied. Minimum and maximum temperatures were calculated from 20 sets of diurnal incoherent-scatter measurements taken at Arecibo, Puerto Rico, which corresponded to a range of 2800-MHz intensity of 120 to 167 × 10^{-22} watt m^{-2} sec^{-1}. Minimum temperatures were also derived from 850 reduced ionosonde records obtained from Ramey, Puerto Rico, for which the 2800-MHz intensity varied between 74 and 252 × 10^{-22} watt m^{-2} sec^{-1}. Both sets of measurements were seasonally distributed. Various combinations of the monthly mean and daily values of the 2800-MHz and Ca-II solar indices were fitted to the data. A formula incorporating the difference between the daily and monthly average Ca-II index and the monthly average 2800-MHz index provided a better fit to all the data than did formulas incorporating only the Ca-II index or the 2800-MHz index alone. The phase and amplitude of the semiannual component and the term dependent on Kp were found to remain almost the same for the maximum and minimum temperature. The term dependent on the 27-day component of the solar activity was found to be about 4 times as large for the diurnal maximum as for the minimum. (auth)

15651 PARAMETRIC DESCRIPTION OF THERMOSPHERIC ION COMPOSITION RESULTS. Taylor, H. A. Jr. (Goddard Space Flight Center, Greenbelt, MD). J. Geophys. Res.; 78: No. 1, 315-319(1 Jan 1973).

OGO satellites have provided data on the ion composition peculiar to specific altitudes in the ionosphere for input to the international reference ionosphere, IRI. The global distribution profiles of O^+, H^+, N^+, He^+, N_2^+, NO^+, and O_2^+ represent the more prominent ionic constituents regularly observed on all orbits over wide ranges of local time, seasons, and magnetic activity. Over the upper-altitude range of the orbits, profiles of O^+, H^+, N^+, and He^+ constitute the primary thermospheric ions and the molecular N_2^+, NO^+, and O_2^+ represent those present on the perigee side of the orbit. The molecular ion distributions show significant latitudinal variation wherein the N_2^+, NO^+, and O_2^+ distributions exhibit a troughlike structure near 20° dipole latitude followed by a strong recovery region near 10°. In the trace ion constituents, D^+ is identified, and its relation to H^+ abundance is discussed. At 8 amu, O^{2+} is identified. Other trace ion constituents include Ne^+ and Mg^+. Other ions are present, but unidentified presently. (JCW)

15652 SOLAR-ECLIPSE EFFECT ON SPORADIC-E IONIZATION. II. Datta, R. N. (University Coll. of Science and Tech., Calcutta). J. Geophys. Res.; 78: No. 1, 320-322(1 Jan 1973).

Previous observations on sporadic E over Haringhata (Calcutta) during the partial solar eclipse of 1955 are critically examined against the background of other relevant information and present knowledge of sporadic E. It appears that the observed variation in sporadic E is related to the redistribution of ionized particles pertinent to the normal E layer and is in conformity with what has been suggested elsewhere for temperate latitude sporadic E. (auth)

15653 SEASONAL VARIATION OF UPPER ATMOSPHERIC SODIUM. Fiocco, G.; Visconti, G. (Univ., Florence). J. Atmos. Terrest. Phys.; 35: No. 1, 165-71(Jan 1973).

The origin of free Na atoms in the upper atmosphere has been attributed to sublimation from dust. The energy budget for the dust particles is considered and their temperature, T_p, and the related Na evaporation rate are estimated. In daytime, T_p can be substantially higher than the ambient gas temperature; the density and temperature fluctuations of the ambient gas control the seasonal variation of T_p and the related Na abundance. (auth)

15654 DIPOLE COORDINATE SYSTEM AND SOME OF ITS CHARACTERISTICS. Fatkulin, M. N.; Sitnov, Yu. S. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 293-295(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 333-334(1972).

A dipole coordinate system is more convenient than a Cartesian or spherical system for the analysis of transport processes in the F region and the topside ionosphere. A dipole approximation is used for the geomagnetic field. An investigation was made of the properties of the dipole coordinate system, its relation to spherical and Cartesian systems, and the necessary relations for conversion from one coordinate system to another were obtained. (JCW)

15655 SEASONAL ANOMALY AT HEIGHTS BELOW THE F2 LAYER ELECTRON DENSITY MAXIMUM AS A FUNCTION OF LATITUDE AND TIME. Boenkova, N. M.; Mednikova, N. V. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 295-297(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 335-336(1972).

An investigation was made of the diurnal and latitudinal characteristics of the manifestation of the seasonal anomaly at various heights on the lower side of the ionosphere. The $n_e(h)$ profiles were examined at Washington, Panama, Talara, Huancayo, Slough, Ibadan, Port Stanley, Moscow, and Puerto Rico on magnetically quiet days at the solar activity maximum (1957–1959). A comparison was made of the winter and summer $n_e(h)$ profiles of each station, assuming that there is a seasonal anomaly at those heights where electron density is higher in winter than in summer. Graphs and figures represent the results. (JCW)

15656 EQUATORIAL ANOMALY IN THE IONOSPHERIC F2 REGION ACCORDING TO VERTICAL SOUNDINGS ABOVE THE PACIFIC OCEAN IN YEARS OF LOW SOLAR ACTIVITY. Goncharov, L. P.; Kudrevskii, A. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 298-300(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 337-339(1972).

An investigation was made of the diurnal variations in the latitudinal distribution of the critical F2-layer frequency in December 1961–January 1962 and December 1962–January 1963. The analysis was made from vertical ionospheric sounding over the Pacific Ocean. The equatorial anomaly in the F2 region is described as the phenomenon that at definite hours of the day the latitudinal distribution of critical F2-layer frequencies shows a minimum near the magnetic equator and two maxima at magnetic dip latitudes of ±25 and ±35°, depending on the longitudinal zone under consideration and the solar-activity cycle. (JCW)

15657 ION AND ELECTRON KINETICS IN A DISTURBED IONOSPHERE AT HEIGHTS OF 100 TO 200 KM. Bykov, B. P.; Kozlov, S. I. Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 300-302(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 340-341(1972).

An investigation was made of the kinetics of ions and electrons at heights h > 100 km in a disturbed atmosphere when the degree of ionization α increases considerably as a result of some effect and N_2^+, O_2^+, and O^+ ions are produced in an approximately direct proportion to the content of N_2, O_2, and O at the same heights. The investigation was limited to $\alpha \ll 1$ and, therefore, it is assumed that the atmosphere does not heat because of the sharp growth of α, i.e., the electron, neutral, and ion gases have vertical temperature distributions that correspond to a normal ionosphere. The computations were made for a broad range of heights, initial electron-density values n_{e0}, daytime and nighttime conditions. The main features of ion and electron kinetics in an appropriately disturbed ionosphere are: 1) The role of N_2^+ is significant only in the first instant of time after the disturbance, which generally does not exceed ~1 sec. 2) The quadratic recombination law predominates at small heights, as it does in the normal ionosphere. But as n_{e0} increases after the disappearance of N_2^+, the rate of change of n_e may also be linear over some period of time. This period increases significantly at greater heights. 3) The behavior of $[NO^+]$ with time differs somewhat from that expected. Even in the upper part of the height range under consideration, the role of this ion is small, except when $n_{e0} < 10^6$ cm^{-3}. 4) In the first approximation, the main molecular ion at all h is O_2^+. 5) The main difference in the behavior of ions and electrons under nighttime and daytime conditions is that the importance of dissociative recombination as the process controlling n_e in time increases and the role of N_2^+ and NO^+ decreases significantly. 6) The time over which electron density decreases from n_{e0} to the normal values of the undisturbed ionosphere depends little on the magnitude of n_{e0}. (JCW)

15658 AURORAL-TYPE SPORADIC E LAYER IN WINTER. Besprozvannaya, A. S.; Sidorova, M. A. Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 303-304(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 342-343(1972).

An analysis was made of sporadic E reflections of the auroral-type at Dixon observed during the winter of 1963–1964. Auroral-type sporadic E is the predominant type of sporadic ionization during the nighttime at Dixon. In these hours the probability of sporadic E occurrence reaches 70 to 80%. There is no E reflection of the auroral type during the daytime. The number of hours per day when E reflections of the auroral type can be observed varies significantly, depending on the magnetic activity level. The diurnal distribution of the difference in the frequency of E_{ss} appearance on magnetically disturbed and quiet days is shown. Maxima occur at 6 and 22h geomagnetic time, indicating that there is an additional flux injection source on magnetically disturbed days, which is absent on magnetically quiet days. It is possible that this source is associated with the precipitation of particles that have been trapped earlier by the magnetic field and drift around the Earth. Apparently the role of these particles decreases with distance from the zone at ϕ = 63 to 68°, and injections on the night side of the Earth associated with phenomena in the magnetotail become the most important. (JCW)

15659 EFFECT OF STRONG RADIO WAVES ON THE IONOSPHERE. Alimov, V. A. (Gorky State Univ., USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 306-308(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 346-347(1972).

Changes take place in the electron density of the ionospheric plasma when strong radio waves act on the ionosphere. Estimates were made of the possible increase or decrease of electron density in the ionosphere under the effects of strong radio waves and their influence on the inhomogeneous structure of the ionosphere were shown. When the electron temperature of the plasma increases, the electron density either decreases because of the displacement of the plasma from the heated region, or increases because of the disturbance of the ionization–recombination balance. In the first case, electron density builds up during the time of ambipolar diffusion of ions from the heated region and in the second case, density builds up during the lifetime of a free electron. Calculations are given for E and F regions. It is noted that considerable decrease in turbidity in the ionosphere F layer occurs under the effect of strong radio waves. (JCW)

15660 EFFECT OF RADIAL DISTRIBUTION OF ELECTRIC CONDUCTIVITY OF THE EARTH ON S_q VARIATIONS. Berdichevskii, M. N.; Van'yan, L. L.; Baynberg, E. B. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 327-329(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 366-368(1972).

Magnetic quiet-day solar daily variations depend on the distribution of the resistivity of the Earth. Two aspects of this problem are a) the average effect of the radial distribution of the resistivity over large regions, and b) the effect of local longitudinal and latitudinal inhomogeneities of resistivity, ρ. The first aspect is investigated. Conclusions derived include: 1) The electric conductivity of the near-surface layer of the Earth in a tangentially homogeneous model has practically no effect on S_q variations. Indeed, the S_q curves for shields and oceans nearly coincide. 2) The electric conductivity of the upper mantle has a much stronger effect on the radial and a weaker one on the tangential field components. For example, the H_θ and H_φ curves, which differ in amplitude by 5 to 10%, and curves H_r whose amplitudes differ by 50 to 80% correspond to models with a depth of 200 and 400 km to the conducting part of the mantle. The picture is approximately the same for the simplified two-layer model of the Earth with a resistivity ρ = 1 and 10 ohm · m. It is significant that an increase in the electric conductivity of the deep layers, as well as the proximity of the well conducting layer to the surface of the Earth lead to a decrease in the amplitude of the radial component H_r. 3) The intermediate conducting layer in the upper mantle can have a noticeable effect on S_q variations. For example, a layer with a longitudinal conductivity of $2 \cdot 10^4$ siemens at a depth of 50 km reduces the H_r amplitude by 30%. Obviously, if the difference between the amplitudes of the observed S_q variations is substantially higher than in the models considered it must be ascribed to the distorting effect of horizontal geoelectric inhomogeneities. (JCW)

15661 HEATING OF THE IONOSPHERE IN A TRANSVERSE ELECTRIC FIELD. Tsedilina, E. E. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 174-179 (1972).

Translated from Geomagn. Aeron.; 12: No. 2, 201-207(1972).

The heating of the ionosphere in a transverse electric field is analyzed. It is demonstrated that an electric field of 20 to 50 mV/m at heights of 400 to 700 km is a strong ionospheric heat source, especially at night. (24 references) (auth)

15662 THREE-LAYER MODEL OF A SMALL-SCALE DYNAMO WITH ALLOWANCE FOR THE HORIZONTAL MAGNETIC-FIELD COMPONENT. Alekseeva, L. M.; Vardanyan, Yu. S. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 180-188(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 208-217(1972).

Ionospheric and magnetospheric currents, the electric field, and charged-particle density disturbances that appear during small-scale motions of the neutral gas in the ionosphere are computed. Use is made of a three-layer model of near-Earth space in which the ionosphere of both hemispheres and the magnetosphere are represented by plane layers with corresponding electrodynamic properties. A magnetic field having both a vertical and a horizontal component is analyzed. (auth)

15663 EQUATIONS OF POTENTIAL ELECTRIC FIELDS IN THE EARTH'S MAGNETOSPHERE AND IONOSPHERE. Krylov, A. L.; Shcherbakov, V. P. (Inst. of Terrestrial Physics, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 189-197(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 218-225(1972).

An iteration method is proposed for obtaining equations describing potential electric fields. It is based on the smallness of the ratio of the transverse and longitudinal conductivities of the magnetospheric and ionospheric plasma. (auth)

15664 GLOBAL DISTRIBUTION OF ELECTRON DENSITY IN THE TOPSIDE IONOSPHERE DURING VARIOUS PHASES OF THE MAGNETIC STORM OF DECEMBER 17–21, 1962. Fatkullin, M. N.; Zayarnaya, E. S.; Mamonova, L. F. (Inst. of Terrestrial

Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 201-205(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 230-236(1972).

Disturbances of electron density in the topside ionosphere and of the F2-layer maximum at middle and low latitudes on the day side of the Earth during various phases of the moderate magnetic storm of December 17–21, 1962, are investigated from Alouette-1 data. (auth)

15665 HEAT INFLUX TO THE ELECTRON GAS AT HEIGHTS h > 180 KM. Gdalevich, G. L.; Shyutte, N. M. (Radio Engineering Inst., Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 231-236(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 266-272(1972).

The heat flux to the electron gas is computed from geophysical rocket data on the density and temperature of electrons and neutral particles. It is demonstrated that the cooling of the electron gas as a result of the excitation of the fine structure of electron levels of atomic oxygen plays a significant role and permits explaining the main characteristics of electron temperature profiles and their relation to the density profiles of electrons and neutral particles. (23 references) (auth)

15666 NONUNIFORMITIES OF THE ION DENSITY AT AN ALTITUDE OF 600 km IN THE IONOSPHERE. Ponomarev, V. N. Cosmic Res. (USSR) (Engl. Transl.) 10: No. 3, 333-9(1972).

Translated from Kosm. Issled.; 10: No. 3, 368-75(1972).

Results of investigations of the planetary distribution and the dynamic characteristics of the large-scale nonuniformities of ion density recorded by the ion data unit on the Kosmos-184 satellite are discussed. (auth)

15667 MgI EMISSION IN THE NIGHT SKY SPECTRUM. Hicks, T. R.; May, B. H.; Reay, N. K. (Imperial Coll. of Science and Technology, London). Nature (London); 240: No. 5381, 401-402(15 Dec 1972).

Observations of a narrow region of the night sky spectrum in the vicinity of the 5183.62-A Mg I wavelength are reported. Measurements were made with a scanning Fabry–Perot interferometer from a Tenerife observatory during September and October 1971 and April 1972. The primary objective was to study the zodiacal light and for this reason all spectra were recorded between evening and morning twilights, and most in the ecliptic plane. Examination of the spectra revealed the presence of a small variable emission core at the center of the zodiacal light Fraunhofer line; the emission wavelength was 5183.6 ± 0.6 A, and the emission was identified as the 5183.61-A line arising from the $3p^3P_2$–$4s^3S$ transition of Mg I. Correlation between the emission and meteor showers was looked for, and some evidence was found for association with the Lyrid shower, indicating that at least part of the atmospheric Mg was of meteoric origin. Radiative recombination of Mg^+ with an electron was the most likely cause of the emission. (UK)

15668 SUNRISE CHANGES IN CONCENTRATIONS OF MINOR NEUTRAL CONSTITUENTS IN THE MESOSPHERE. Bowman, M. R.; Thomas, L. (SRC Radio and Space Research Station, Slough, Eng.). J. Atmos. Terrest. Phys.; 35: No. 2, 347-352 (Feb 1973).

The results of a numerical study of an oxygen–hydrogen atmosphere are used to examine the detailed variations of $O(^3P)$, O_3, H, and OH concentrations at selected heights in the mesosphere during the sunrise period. (auth)

15669 MID-LATITUDE WINTER ANOMALIES IN RADIO ABSORPTION AND STRATOSPHERIC TEMPERATURE DISTRIBUTION. OBSERVATIONS CONCERNING THE INFLUENCE OF AURORAL AND MAGNETIC ACTIVITY. Hargreaves, J. K. (Univ. of Lancaster, Eng.). J. Atmos. Terrest. Phys.; 35: No. 2, 291-304(Feb 1973).

Measurements of ionospheric radio absorption, made at Lancaster during the winters of 1970 to 1971 and 1971 to 1972, are used to investigate the influence of auroral and magnetic activity in the midlatitude winter absorption anomaly. Two kinds of influence are identified. First, it is found that the absorption at 2.14 MHz tends to be enhanced by 10 decibels or more on single days of high activity, probably as a direct consequence of energetic-particle precipitation. Second, the more extended anomalies, associated with stratospheric warmings, tend to follow several days after extended periods of high geophysical activity. The evidence suggests that the influence of auroral activity may extend down to the 40 km level on some occasions and there play a part in the development of a warming, the characteristic behavior seen at 40 km being the growth of a hot region and its movement towards the pole. (auth)

15670 FULL-WAVE STUDY OF ION-CYCLOTRON WHISTLERS IN THE IONOSPHERE. Fijalkow, E.; Altman, C.; Cory, H. (Technion-Israel Inst. of Tech., Haifa). J. Atmos. Terrest. Phys.; 35: No. 2, 317-337(Feb 1973).

A generalized multiple-reflection full-wave method was used to study ion-cyclotron whistlers in the ionosphere. At a frequency of 400 Hz, about 25% of the incident electron whistler energy below the ionosphere is available for ion whistler production at the crossover level for nearly all angles of incidence, the figure being reduced by a factor of 4 at 100 Hz. At the crossover level the same typical coupling pattern is obtained for widely varying wave and collision frequencies and altitudes. As a function of θ, the angle between the wave normal and the magnetic-field direction, the R-mode flux drops to half-power near $\theta = 25°$, where it equals that of the L mode, and drops to zero near $\theta = 40°$, where the L mode peaks. The relation of θ to the critical coupling angle θ_c has negligible effect on the coupling pattern, which is determined primarily by "limiting polarization" effects, stemming from the proximity of the R and L refractive indices for $0 \leq \theta \lesssim 20°$. There is negligible reflection or mode conversion at the gyrofrequency levels where the L mode is completely absorbed, and for high ionic collision frequencies there is appreciable absorption of the L mode above crossover, especially for large θ. At very low geomagnetic latitudes the proton gyrofrequency and crossover levels tend to merge, and for most frequencies only the electron whistler will be observed. (auth)

15671 STUDY OF THE RELATION BETWEEN THE FREQUENCY PARAMETERS OF THE SPORADIC E LAYER. Babaev, A. (Institut Fiziki Zemli i Atmosfery, Ashkhabad, USSR). Izv. Akad. Nauk Turkm. SSR, Ser. Fiz.-Tekh., Khim. Geol. Nauk; No. 4, 92-95(1971). (In Russian).

Correlation factors for the shielding frequency and the limiting reflection frequency of the sporadic-E layer are calculated by the hour of the day from observations at nine stations located in different parts of the globe. Similar diurnal data from other three stations are also used in the calculations. Curves are plotted to illustrate the results. (IAA)

15672 VERTICAL RADIATION STRUCTURE (HORIZONTAL INHOMOGENEITY) OF THE EARTH UPPER ATMOSPHERE RADIATION FROM OBSERVATIONS BY THE SPACESHIP SOYUZ-3. Beregovoi, G. T.; Buznikov, A. A.; Kondrat'ev, K. Ya.; Lazarev, A. I.; Smoktii, O. I. Dokl. Akad. Nauk SSSR; 206: No. 3, 601-604(21 Sep 1972). (In Russian).

Visual observations of the vertical-ray structure were made of the radiation of the upper atmosphere of the Earth during the flight of spaceship Soyuz-3, October 29, 1968 (1900 Moscow time). A strongly evident horizontal inhomogeneity in radiation was manifest in the upper reaches of the Earth's atmosphere. (KSW)

15673 INVESTIGATIONS OF HIGH-ENERGY CHARGED PARTICLES AND VLF RADIATION WITH THE INTERKOSMOS 3 SATELLITE. Vakulov, P. V.; Vesely, V.; Voita, Ya.; (and others). Cosmic Res. (USSR) (Engl. Transl.); 10: No. 3, 345-51(1972).

Translated from Kosm. Issled.; 10: No. 3, 382-9(1972).

General information is given on the scientific experiments carried out with the Interkosmos 3 satellite. This satellite was launched in 1970 into an orbit with 206-km perigee, 1315-km apogee, and a 48°.4 inclination of the orbit plane to the equator. The instrument package included detectors for recording high-energy protons and electrons and vlf emissions, as well as a three-component magnetometer. Over its four-month lifetime the satellite yielded a great deal of scientific data, which are now being analyzed. A brief description is given of the instrumentation and the measurement procedures. Examples of the information acquired are presented, both for a relatively quiet period and for a period after a strong geomagnetic storm. A correlation is found between an enhanced intensity of vlf radiation and the flux of high-energy particles. (auth)

15674 MAGNETICALLY COUPLED TRANSPORT OF A COLD PLASMA IN THE OUTER IONOSPHERE AT LOW LATITUDES. Sitnov, Yu. S.; Fatkullin, M. N. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 3, 413-16(1972).

Translated from Kosm. Issled.; 10: No. 3, 459-61(1972).

A theoretical investigation was made of the transport of a cold plasma (by means of longitudinal ambipolar diffusion) along the lines of force of the Earth's magnetic field between two isometric maxima in the equatorial anomaly with the following assumptions: (1) in the ionic composition of the upper ionosphere at heights $h \lesssim$ 700 to 900 km, O^+ oxygen ions predominate, assuming approximately that $n_e = n(O^+) = N$; (2) only longitudinal ambipolar diffusion is considered among the processes of charged-particle transport; (3) the medium is isothermal; (4) the distribution of oxygen-atom concentration with height is given in the form $n(O) = n_R(O)\exp[-(r - R)/H(O)]$, where $H(O)$ is the height scale of atomic oxygen, $R = R_o + h_o$, R_o is the radius of the Earth, and h_o is the

height above the surface of the Earth; and (5) the processes of photoionization of the neutral components of the upper atmosphere under the action of short-wave solar radiation and the recombination of electrons and ions are not taken into account. These conditions are also satisfied for the upper F2 region. The stationary approximation that is considered does not allow an accurate estimate of the time needed for the original values of n_e at the two coupled points to be equalized. According to the approximate estimates made, the equalization process occurs sufficiently slowly. (JCW)

15675 TWO-BEAM OBSERVATIONS OF IONOSPHERIC IRREGULARITY STRUCTURE AND VELOCITY AT ARECIBO. Brice, N. M. (Cornell Univ., Ithaca, NY); Conrad, J. C.; La-Londe, L. M.; Steinfeld, A. H. Radio Sci.; 8: No. 1, 39-46(Jan 1973).

A new technique has been developed for measuring irregularity structure and velocity in the ionospheric E and F regions. The Arecibo incoherent-scatter radar was modified to measure electron-density profiles simultaneously with two beams: one fixed beam pointed at the zenith, and a second beam could be varied over 360° in azimuth and from 2 to 20° in zenith angle. Fluctuations in ionization density were observed to drift from one beam to the other so that information was obtained about both the horizontal velocity and the structure of these disturbances. Velocities of 100 to 200 m sec^{-1} and horizontal scale sizes of 50 to 100 km were deduced for the E region and roughly 400 m sec^{-1} and 500 km for the F region. A plot of velocity versus altitude shows a spiral structure with a vertical wavelength of 20 to 30 km in the E region. (28 references) (auth)

15676 MODIFIED MONTE CARLO MODEL FOR THE IONOSPHERIC HEATING RATES. Mayr, H. G. (Goddard Space Flight Center, Greenbelt, MD); Fontheim, E. G.; Robertson, S. C. Radio Sci.; 8: No. 1, 47-49(Jan 1973).

Following Cicerone and Bowhill, a Monte Carlo method is adopted as a basis for the derivation of the photoelectron-heat input into the ionospheric plasma. Considering that the size of the source elements must be small compared with the range over which photoelectrons dissipate their energy, a great number of Monte Carlo runs are required normally for the computation of the heating rates. This approach is modified in an attempt to minimize the computation time. The heat-input distributions are computed for arbitrarily small source elements that are spaced apart at distances corresponding to the photoelectron dissipation range. By means of a nonlinear interpolation procedure their individual heating-rate distributions are utilized to produce synthetic ones that fill the gaps between the Monte Carlo-generated distributions. By varying these gaps and the corresponding number of Monte Carlo runs the accuracy of the results is tested to verify the validity of this procedure. It is concluded that this model can reduce the computation time by as much as an order of magnitude, thus improving the feasibility of including Monte Carlo calculations in self-consistent ionosphere models. (auth)

Effects of Nuclear Detonations

Refer also to abstract 14686.

15677 (AD-745884) SURVEY OF STUDIES OF ATMOSPHERIC TRANSMISSION FROM A 4 π LIGHT SOURCE TO A 2 π RECEIVER. Cantor, Israel (Army Electronics Command, White Sands Missile Range, N. Mex. Atmospheric Sciences Lab.). Apr 1972. 58p. (ECOM-5435). NTIS.

The survey report attempts to point out the progress and insufficiencies in the assessment and prediction of atmospheric effects on thermal radiation from a nuclear detonation in the troposphere to a target at the ground. The approach consists of a summarization of the major findings of investigators during the past two decades that relate the thermal transmission from an effective point light source in the troposphere to a flat plate or 2 pi steradian receiver at the ground. (auth)

Magnetospheric Phenomena

Refer also to abstracts 14811, 15486, 15488, 15561, 15579, 15662, 15663, and 16342.

15678 (AD-743549) TRAPPED RADIATION STUDIES INVOLVING PLASMA INSTABILITIES AND RADIAL DIFFUSION. Annual Report, January 1971–February 1972. Cladis, J. B.; Davidson, G. T.; Francis, W. E.; Futterman, W. I.; Newkirk, L. L. (Lockheed Missiles and Space Co., Palo Alto, Calif. Lockheed Palo Alto Research Lab.). Apr 1972. Contract DASA01-71-C-0047. 52p. (LMSC/D-246353; DNA-2824-F). NTIS.

The generation of unstable waves in the magnetosphere is reviewed, with emphasis on waves occurring near the trapped particles' gyrofrequencies. Relativistic modifications to the basic theory are described. The evolution of trapped particles' distribution (diffusion) is discussed, and the nonlinear theories of wave propagation and growth are invoked as the means whereby the evolution of the distribution functions can be studied. It is pointed out that, because of difficulties in the analytic theories, computer simulation may be the most certain technique for investigating effects of unstable waves on particles. Some particular unsolved problems are indicated, with special emphasis on trapping of artificially injected electrons. The development of a computer program which simulates actual physical processes in the magnetosphere is described. (auth)

15679 (AD-743888) OBSERVATION OF VLF WHISTLER-MODE WAVES PECULIAR TO THE RADIATION BELT SLOT. Report for April 1968–July 1971. Koons, H. C.; McPherson, D. A. (Aerospace Corp., El Segundo, Calif.). 22 May 1972. Contract F04701-71-C-0172. 22p. (SAMSO-TR-72-110). NTIS.

Vlf emissions between 3.9 and 10.4 kHz are observed at high altitudes in the slot region (L ~ 2.5 to 3.6) by a receiver aboard spacecraft OV1-14 (1968-26B). The maximum spectral intensities of 1.1 $\mu\gamma/Hz^{1/2}$ and 2.8 $\mu V/Hz^{1/2}$ on the magnetic and electric antennas, respectively, occur in the 5.6-kHz channel. The waves can resonantly interact with energetic electrons above 50 keV at L = 2.5, and the measured wave intensities are ample to account for the observed lifetimes of medium-energy electrons in the slot region. (auth)

15680 (AD-745789) ELECTRIC FIELD AND PLASMA OBSERVATIONS IN THE MAGNETOSPHERE. Progress Report. Gurnett, D. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). May 1972. Contract N00014-68-A-0196-0003. 42p. NTIS.

Satellite-borne electric-field measurements using the double-probe technique have now provided a comprehensive survey of convection electric fields at low altitudes in the magnetosphere. The most prominent features of the convection electric fields are reversals located at high magnetic latitudes, with generally anti-sunward convection poleward and sunward convection equatorward of the electric-field reversal location. The electric-field reversal is usually coincident with the "trapping boundary" for electrons with energies E > 45 keV and is interpreted as the boundary between open and closed magnetic-field lines. On the day side of the magnetosphere the electric-field reversal is observed to coincide with the equatorward boundary of the polar cusp. (auth)

15681 (AD–746326) AEROSPACE CORPORATION SPACE SCIENCE PROGRAM REPORT TO COSPAR CY 1971. Report for January–December 1971. Paulikas, G. A. (Aerospace Corp., El Segundo, Calif.). 31 Dec 1971. Contract F04701-71-C-0172. 20p. (SAMSO-TR-72-169). NTIS.

Results obtained during 1971 by the Space Research Program of The Aerospace Corporation are presented. The results deal with magnetospheric physics and the physics of the upper atmosphere. (auth)

15682 (N–72-25339) EFFECT OF MODIFIED THERMAL CONDUCTIVITY ON THE TEMPERATURE DISTRIBUTION IN THE PROTONOSPHERE. Mayr, H. G.; Fontheim, E. G.; Mahajan, K. K. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Apr 1972. 13p. (NASA-TM-X-65900; X-621-72-107). NTIS.

At typical protonospheric electron densities, the electron mean free path is long enough that the coefficient of thermal conductivity is no longer given by Spitzer's expression. The effect on the temperature profile of using the corrected expression for conductivity is investigated. The corrected thermal conduction coefficient is density-dependent and has a more complicated temperature dependence than the coefficient applicable to higher-density plasmas. The results indicate that the effect is not negligible even under quiet conditions and at low latitudes. (auth)

15683 (N–72-25340) UNIPOLAR INDUCTION IN THE MAGNETOSPHERE. Stern, D. P. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). May 1972. 38p. (NASA-TM-X-65893; X-641-72-133). NTIS.

A theory is described for the production of electric currents in the magnetosphere and for the transfer of energy from the solar wind to the magnetosphere. Assuming that the magnetosheath has ohmic-type conduction properties, it is shown that unipolar induction can energize several current flows, explaining the correlation of the east–west component of the interplanetary magnetic field with polar electric fields and polar magnetic variations. In the tail region, unipolar induction can account for effects correlated with the north–south component of the interplanetary magnetic field. (auth)

15684 (N-72-25726) MAGNETOSPHERIC ACCESS OF SOLAR PARTICLES AND THE CONFIGURATION OF THE DISTANT GEOMAGNETIC FIELD. VOLUME 1. Evans, L. C. (California Inst. of Tech., Pasadena). 1972. Contract NAS5-3095. 164p. (NASA-CR-122359). NTIS.

Thesis.

The access of 1.2- to 40-MeV protons and 0.4- to 1.0 MeV electrons from interplanetary space to the polar-cap regions was investigated with an experiment on board 0604. A total of 333 quiet-time observations of the electron polar-cap boundary give a mapping of the boundary between open and closed geomagnetic-field lines. Observations of events associated with corotating regions of enhanced proton flux in interplanetary space were used to establish the characteristics of the 1.2- to 40-MeV-proton access windows. The results were compared to particle access predictions of the distant geomagnetic-tail configurations. The role played by interplanetary anisotropies in the observation of persistent polar-cap features is discussed. Special emphasis is given to the problem of nonadiabatic particle entry through regions where the magnetic field is changing direction. (auth)

15685 (N-72-25727) MAGNETOSPHERIC ACCESS OF SOLAR PARTICLES AND THE CONFIGURATION OF THE DISTANT GEOMAGNETIC FIELD. VOLUME 2. Evans, L. C. (California Inst. of Tech., Pasadena). 1972. Contract NAS5-3095. 120p. (NASA-CR-122360). NTIS.

Thesis.

A summary is provided of all proton events observed with OGO 4 and observed flux profiles for several events. Pertinent data are indicated relating to the orientation of the interplanetary magnetic field. The events whose profiles are presented are divided into three classes: EDP events (normally associated with corotating features), solar-flare events, and events having characteristics of both EDP events and flare events (class C events). A description of these classes of events and the criteria used to distinguish between EDP events and flare events are discussed. In addition, the December 1, 1967, EDP event and the November 2, 1967, solar flare event are discussed in some detail. Accompanying the profiles of each event is a brief list of notable observational features of the event. Events are presented chronologically. (auth)

15686 (N-72-26267) STUDY ON MULTISATELLITE, MULTIMEASUREMENT OF THE STRUCTURE OF THE EARTH'S BOW SHOCK. Final Report. (TRW Systems Group, Redondo Beach, Calif.). 10 Mar 1972. Contract NASw-2186. 94p. (NASA-CR-127062; TRW-17873-6006-RO). NTIS.

The pulsation model of the Earth's bow shock proposed a nonuniform shock having both perpendicular (abrupt, monotonic) and oblique (oscillatory, multigradient) properties simultaneously, depending on local orientation of the shock surface to the interplanetary field B_{sw} in parallel planes defined by B_{sw} and solar-wind velocity. Multiple, concurrent, satellite observations of the shock and solar-wind conditions were used. Twenty-six potentially useful intervals of concurrent Explorer 33 and 35 data acquisition were examined, of which six were selected for closer study. In addition, two years of OGO-5 and HEOS-1 magnetometer data were examined for possible conjunctions to these spacecraft having applicable data. One case of clear nonuniformity and several of field-dependent structure were documented. A computational aid, called pulsation index, was developed. (auth)

15687 (N-72-27350) OBSERVED RELATIONSHIPS BETWEEN ELECTRIC FIELDS AND AURORAL PARTICLE PRECIPITATION. Gurnett, D. A.; Frank, L. A. (Iowa Univ., Iowa City. Dept. of Physics and Astronomy). Apr 1972. Contract NAS5-10625. 79p. (NASA-CR-127254). NTIS.

Simultaneous electric field and plasma observations with the low-altitude, polar-orbiting satellite Injun (Hawkeye) 5 provided a comprehensive survey of convection electric fields and their association with magnetospheric plasma phenomena. The most prominent features of the convection electric fields are reversals located at high magnetic latitudes, with generally anti-sunward convection poleward convection equatorward of the electric-field reversal location. The electric-field reversal is interpreted as the boundary between open and closed magnetic-field lines. To investigate the electric field and plasma interrelationships during a polar magnetic substorm, a series of passes obtained prior to and during a substorm is presented. Large, anti-sunward convection velocities were detected over the polar cap several tens of minutes before the onset of the expansive phase of the substorm. These convection velocities gradually decreased during the decay phase of the substorm. Measurements of enhanced anti-sunward flow over the polar-cap region are generally consistent with concepts of the origin of substorms. (auth)

15688 DAILY RANGE OF THE H COMPONENT OF GEOMAGNETIC FIELD IN AND NEAR THE ELECTROJET. Misra, R. K. (Physical Research Lab., Ahmedabad, India). Curr. Sci. (India); 41: No. 24, 863-6(20 Dec 1972).

Characteristics and interrelations of the solar daily variations of H at Trivandrum, a station within the equatorial electrojet and at Alibag, a low-latitude station, during a low sunspot period are discussed. It is shown that any change in the daily range ΔH at Alibag is contributed 63% by the decrease of instantaneous minimum value of H (H_{min}) and only 37% by the increase of instantaneous maximum value of H (H_{max}), whereas the contribution of the two effects is equal for Trivandrum. Using the rSq type of daily range of H, it is found that, when a large number of days are considered, the daily range at the equator is predominantly due to the increase of daytime value of H. It is also shown that there is a very high correlation between H_{min} at the two stations and a rather poor correlation between the H_{max} values, indicating that the nighttime changes in H are produced by currents at great heights. (auth)

15689 PROPAGATION ANISOTROPIES OF SOLAR FLARE PROTONS AND ELECTRONS AT LOW ENERGIES IN INTERPLANETARY SPACE. Pyle, K. R. (Univ. of Chicago). J. Geophys. Res.; 78: No. 1, 12-28(1 Jan 1973).

Flux anisotropies in interplanetary space were investigated for protons with E > 0.66 MeV and electrons with E > 400 keV. Data were taken from the University of Chicago charged-particle telescope aboard the deep-space probe Pioneer 7 and from the Goddard Space Flight Center magnetometer aboard the same spacecraft. Flux anisotropies lying to the east of the average interplanetary magnetic field direction were first reported by McCracken et al., (1971), late in a solar particle event, for proton energies >7.5 MeV. This work extends this investigation to much lower proton energies, studies the proton and electron anisotropies during both early and late phases of a particle event, and makes use of detailed magnetic-field data. The investigation consists of two parts, a study of many periods taken at random during solar events, for both protons and electrons, and a detailed analysis of one period, early in an event, during which the magnetic field was near the solar direction. In the first part the study shows that the proton and electron anisotropies are almost always directed from east of the magnetic-field direction. In the case of the 400-keV electrons, the very small Compton-Getting anisotropy allows a direct measurement of the flux, indicating an electron flux transverse to the average field direction. For the protons, since no selection was made favoring late or early phases of the particle events, the fact that an eastward anisotropy is always measured leads to the conclusion that a low-energy proton flux component is present transverse to the field. For the case studied in detail, detailed time resolution was obtained of the proton anisotropy at energies >0.66 MeV. This was compared with fine-scale magnetic-field measurements, establishing the presence of a constant offset between field and anisotropy direction, even at times when the magnetic field was in the solar direction. This observation establishes directly the existence of a significant low-energy proton flux component transverse to the average interplanetary-field direction. (auth)

15690 PITCH-ANGLE DISTRIBUTION OF SOLAR-FLARE PARTICLES IN INTERPLANETARY SPACE. Maurer, R. H.; Duggal, S. P.; Pomerantz, M. A. (Franklin Inst, Swarthmore, PA). J. Geophys. Res.; 78: No. 1, 29-36(1 Jan 1973).

During the initial anisotropic phase of solar-particle events, the flux in the radial direction is considerably less than that from the garden-hose field direction. An analysis based on the theory of charged-particle transport in random magnetic fields has been conducted to determine the pitch-angle distribution of particles with respect to the garden-hose field lines. With the commonly observed magnetic-field power spectral density functions, the model reveals that the flux is proportional to cos δ, where δ represents the angular separation from the garden-hose direction. This theoretical result is verified by the analysis of relativistic solar-particle observations during the appropriate anisotropic phases of several otherwise dissimilar ground-level events; i.e., those of May 4, 1960; November 12, 1960; November 18, 1968; and February 25, 1969. (auth)

15691 STRONG PITCH-ANGLE DIFFUSION AND MAGNETOSPHERIC SOLAR PROTONS. Williams, D. J. (Space Environment Lab., Boulder, CO); Heuring, F. T. J. Geophys. Res.; 78: No. 1, 37-50(1 Jan 1973).

Observations of 1.2- to 2.2- and 2.2- to 8.2-MeV solar protons at low altitudes are studied with emphasis on the interaction zone between the stable trapping regions and the high-latitude polar-cap region. The data show: the appearance of anisotropic loss-cone distribution, indicative of particle trapping, near the cutoff latitude on the dayside hemisphere only; the motion of the anisotropic region to invariant latitudes as the geomagnetic storm develops and the subsequent development of an isotropic loss-cone distribution;

and the movement of the solar proton distribution to stable trapping regions well within the ≥280-keV electron trapping boundary. An explanation for these phenomena is offered in terms of cross-L diffusion in the nightside hemisphere along with the development of some strong pitch-angle diffusion process at all longitudes, which drives the ~1-MeV solar protons to isotropy in the loss cone. The development of strong pitch-angle diffusion is strongly linked to the development of the symmetric ring current. This explanation may account for the relative inefficiency of direct solar proton injection as a source of trapped protons in spite of the fact that the solar protons have access to the stable trapping regions. Although the ~1-MeV proton lifetimes will be governed by the pitch-angle diffusion process, it is important to note that the minimum pitch-angle diffusion lifetime is of the order of or larger than ~1-MeV proton drift periods in the region $L \geq 4$ R_E. These effects may also explain the longitudinal uniformity of PCA on the dayside hemisphere as well as some of the PCA "midday recovery." (42 references) (auth)

15692 FURTHER STUDY OF THE θ COMPONENT OF THE INTERPLANETARY MAGNETIC FIELD. Rosenberg, R. L. (Univ. of California, Los Angeles); Coleman, P. J. Jr.; Ness, N. F. J. Geophys. Res.; 78: No. 1, 51-58(1 Jan 1973).

Measurements of the interplanetary magnetic field taken with Imp 3, Pioneer 6, and Explorer 34 constitute a large portion of the data available at low and moderate solar activity and provide nearly continuous coverage from mid-1965 through 1966 without radial effects. Study of these observations provides further evidence for the following B_θ effect initially discovered with Mariners 2, 4, and 5. At low or moderate solar activity, the mean value of B_θ is negative (approximately northward in the observations) above the solar equatorial plane and positive below it for an interplanetary field directed outward from the Sun, and vice versa for an inward field. Thus, for an outward field the $r-\theta$ component of a line of magnetic force above or below the equatorial plane was skewed relative to $\hat{r}$ in the direction away from the equatorial plane. Comparisons between different spacecraft are discussed. (auth)

15693 RELATION BETWEEN SOLAR-WIND STRUCTURE AND SOLAR-WIND ROTATIONAL AND TANGENTIAL DISCONTINUITIES. Turner, J. M. (Massachusetts Inst. of Tech., Cambridge). J. Geophys. Res.; 78: No. 1, 59-70(1 Jan 1973).

Solar-wind plasma and magnetic-field data were used to identify rotational and tangential discontinuities during the first 40 days of the flight of Mariner 5. Of the 40 rotational discontinuities found, 36 were clustered in three distinct 3- to 6-day intervals. These three intervals were characterized by high solar-wind bulk velocities, high magnetic-field magnitudes, low densities, high correlation between velocity and magnetic-field changes, and the presence of smooth Alfvén waves. The rotational discontinuities had magnetic-field changes that were generally close to the direction of magnetic-field changes for smooth Alfvén waves. Although the primary component of these changes was perpendicular to the equatorial plane for both, the radial component for the discontinuities was generally larger. The normals to the tangential discontinuity surfaces strongly preferred a direction near the ecliptic plane and perpendicular to the spiral field direction. For quiet plasma streams there is evidence suggesting that the least likely directions of changes in B and V near the discontinuity tended to be distributed along the normal to the discontinuity surface. In disturbed plasma streams the magnetic field also behaved as it did in the quiet stream case, whereas the velocity confinement was only true at the discontinuity and did not persist away from the discontinuity. The least likely directions of change for the magnetic field and velocity near the discontinuities were different from those found overall for the 40 days studied. An examination of the qualitative features of fast and slow plasma streams revealed differences in the behavior of the magnetic field and velocity and their fluctuations, the field magnitude, and the density. It is suggested that these differences are correlated with the occurrence of rotational discontinuities. (auth)

15694 INTERPRETATION OF OGO 5 LYMAN-ALPHA MEASUREMENTS IN THE UPPER GEOCORONA. Bertaux, J. L.; Blamont, J. E. (CNRS, Verrieres-le-Buisson, France). J. Geophys. Res.; 78: No. 1, 80-91(1 Jan 1973).

Lyman-α intensity measurements (1216 A) were obtained by a photometer on board the Ogo-5 spacecraft outside the geocorona. The Lyman-α emission originating from hydrogen atoms in the upper part of the geocorona was derived from the total measured intensity after subtraction of the extraterrestrial emission. The hydrogen density distribution between 5 and 16 R_E was deduced. This distribution is consistent with the evaporative atmospheric model of J. W. Chamberlain on the night side. A depletion of atoms found above a distance of 6 R_E on the day side could be accounted for by the action on satellite particles of charge exchange with solar-wind protons and by the solar Lyman-α radiation pressure, according to numerical computations of both effects. It was also calculated that orbits with a perigee of 2 R_E are rapidly distorted by radiation pressure. The mean time spent in the exosphere by satellite particles on such orbits is only 5×10^5 sec, one-half the ionization lifetime. (auth)

15695 SUBSTORM VARIATIONS OF THE MAGNETOTAIL PLASMA SHEET FROM $X_{SM} \approx -6$ R_E TO $X_{SM} \approx -60$ R_E. Hones, E. W. Jr.; Asbridge, J. R.; Bame, S. J.; Singer, S. (Los Alamos Scientific Lab., NM). J. Geophys. Res.; 78: No. 1, 109-132(1 Jan 1973).

A study of the substorm-related variations of the magnetotail plasma sheet is discussed. The study uses data, much of it previously published, obtained by Vela and Imp satellites in the range -6 $R_E > X_{SM} > -60$ R_E, where X_{SM} is geocentric distance measured along the solar magnetospheric x axis. Evidence is presented that the thickening or recovery of the plasma sheet, which has been shown in Vela satellite measurements (at $r \approx 18$ R_E) to occur late in substorms, is causally related to a rapid poleward shift or "leap" of the principal current of the auroral electrojet evidenced by recovery of magnetic bays at auroral latitudes ($65° \lesssim \lambda_m \lesssim 70°$) and their onset at low polar-cap latitudes (e.g., $\lambda_m \approx 74°$). That is, it appears to be inaccurate to regard the thickening of the plasma sheet in the far magnetotail as a process that commences near the Earth at the onset of the expansive phase of a substorm and moves more or less uniformly out into the tail as the expansive phase of the substorm evolves. A schematic description of the responses of the plasma sheet to a substorm, based on this study and previous studies, is presented. (30 references) (auth)

15696 DRIFT SHELL SPLITTING BY INTERNAL GEOMAGNETIC MULTIPOLES. Roederer, J. G. (Univ. of Denver); Hilton, H. H.; Schulz, M. J. Geophys. Res.; 78: No. 1, 133-144(1 Jan 1973).

Computations on an 80-coefficient model of the Earth's field illustrate the "topography" of the magnetic equatorial surface (on which $\mathbf{B} \cdot \nabla B = 0$) and the geometry of the drift shells of geomagnetically trapped particles. Individual terms in the spherical harmonic expansion (offset dipole coordinates) of the geomagnetic scalar potential $V(r, \theta, \varphi)$ are either even or odd in $\cos\theta$, where $\theta = \pi/2$ denotes the dipole equator. Terms that (unlike the dipole) are even in $\cos\theta$ tend to "warp" the equatorial surface, but do not (in first order) distort particle drift shells radially nor split the drift shells of particles having different equatorial pitch angles. Azimuthally asymmetric terms that are odd in $\cos\theta$ do cause shell splitting in first order. Shell splitting at large L values (neglecting deformation of the Earth's field by the solar wind) is found to be dominated by the geomagnetic octupole. At $L \sim 1$, shell splitting is strongly enhanced by the South American and South African anomalies. When combined with pitch-angle diffusion caused by atmospheric scattering, these results may be able to account for anomalous radial diffusion of inner zone electrons (as observed at $L \lesssim 1.2$). (31 references) (auth)

15697 OBSERVED RELATIONSHIPS BETWEEN ELECTRIC FIELDS AND AURORAL PARTICLE PRECIPITATION. Gurnett, D. A.; Frank, L. A. (Univ. of Iowa, Iowa City). J. Geophys. Res.; 78: No. 1, 145-170(1 Jan 1973).

Simultaneous electric field and plasma observations with the low-altitude polar-orbiting satellite Injun 5 have provided a comprehensive survey of convection electric fields and their association with magnetospheric plasma phenomena. The most prominent features of the convection electric fields are reversals located at high magnetic latitudes, with generally antisunward convection poleward and sunward convection equatorward of the electric-field reversal location. The electric-field reversal is interpreted as the boundary between open and closed magnetic-field lines. During local day the electric-field reversal is observed to coincide with the equatorward boundary of the polar cusp. The plasma flow in the dayside polar cusp region is dominantly E–W, away from the stagnation point, the convection velocities typically being ~1 km sec^{-1}. At local evening, "inverted-V" electron precipitation bands are observed near or at the position of the electric-field reversal. In the local late-evening sector the electric-field reversal becomes less distinct, and often no single well-defined electric field reversal can be identified. In all cases the inverted-V electron precipitation events are closely associated with large, typically >30 mV m^{-1}, irregular electric-field fluctuations with time scales of a few seconds or less. Often these fluctuations comprise distinct "spikes" of a few seconds duration or less, which can be identified with distinct boundaries or other features of the electron precipitation. In the local midnight sector, convection electric fields of >50 mV m^{-1} associated with plasma sheet electrons have been observed extending deep into the magnetosphere, equatorward of the electron (E > 45 keV) trapping boundary. These convection-electric fields are characterized by considerably smaller fluctuations relative to those observed within the inverted-V electron

precipitation bands. To investigate the electric field and plasma interrelationships during a polar magnetic substorm, a series of passes obtained before and during a substorm is presented. Large antisunward convection velocities were detected over the polar cap several tens of minutes before the onset of the expansive phase of the substorm. These convection velocities gradually decreased during the decay phase of the substorm. Our measurements of enhanced antisunward flow over the polar-cap region are generally consistent with several current ideas concerning the origin of substorms. (31 references) (auth)

15698 SEMI-EMPIRICAL MODEL OF LARGE-SCALE MAGNETOSPHERIC ELECTRIC FIELDS. Volland, H. (Univ., Bonn). J. Geophys. Res.; 78: No. 1, 171-180(1 Jan 1973).

Semi-empirical analytic formulas for large-scale electric magnetospheric fields are developed that are valid within the inner magnetosphere as well as within the ionosphere. These electric fields drive ionospheric electric currents. Moreover, field-aligned electric currents must exist in order to maintain the magnetospheric electric-field configuration. The model calculations are compared and are shown to be consistent with the shape of the plasmapause, the equivalent electric-current systems of DP 1 and DP 2, the available electric-field observations at ionospheric altitudes, and the observations of field-aligned electric currents. (31 references) (auth)

15699 WHISTLER MODULATIONAL INSTABILITY. Brinca, A. L. (Stanford Univ., CA). J. Geophys. Res.; 78: No. 1, 181-190 (1 Jan 1973).

The modulational instability characteristics of whistlers in cold and hot plasmas were discussed. The cold-plasma analysis considers both ion motion and relativistic effects; the unstable band, with a growth rate proportional to $(B/B_0)^2$, is contiguous to $\Omega_e/4$ and, depending on the plasma density, lies above or below that frequency (Ω_e is the electron cyclotron frequency of the static magnetic field; B and B_0 are the whistler and static magnetic fields). In hot plasmas, stability occurs between $\Omega_e/4$ and $\Omega'(<\Omega)_e$, with Ω' depending mainly on the mean energy and anisotropy of the energetic electron population; the complementary unstable band has a growth rate proportional to $(B/B_0)^{1/2}$. The relevance of the instability to whistlers in the magnetosphere is discussed. (auth)

15700 INCOHERENT CHERENKOV RADIATION IN THE MAGNETOSPHERE AND THE GROUND OBSERVATIONS OF VLF HISS. Rao, M.; Dikshit, S. K.; Tantry, B. A. P. (Banaras Hindu Univ., India). J. Geophys. Res.; 78: No. 1, 191-196(1 Jan 1973).

The minimum enhancement factors required to trap the vlf energy radiated by the energetic particles in the incoherent Cherenkov mode were calculated. The magnetospheric model chosen is the same as that used by T. S. Jørgensen (1968) in his attempt to account for the observed power fluxes of "auroral" hiss in terms of the incoherent Cherenkov radiation. The research yields values for the peak to valley ratios of electron-density inhomogeneities that must be present at various heights in the magnetosphere to guide the incoherent Cherenkov radiation toward the ground. It is also pointed out that, at frequencies for which at some height the LHR frequency is encountered, the spectral densities of incoherent Cherenkov radiation reaching the ground would be less than those calculated by Jørgensen. (auth)

15701 INTERACTION OF SINGLY CHARGED INTERSTELLAR HELIUM IONS WITH THE SOLAR WIND. Wu, C. S. (Univ. of Maryland, College Park); Hartle, R. E.; Ogilvie, K. W. J. Geophys. Res.; 78: No. 1, 306-309(1 Jan 1973).

Descriptions were given for two mechanisms that should lead to He^+ ions that are assimilated with the solar wind at 1 AU, i.e., ions thermalized and moving with bulk speed equal to that of the solar wind. The first mechanism considered the collective plasma instability recently identified theoretically by Wu and Davidson (J. Geophys. Res., 1972) in which the transverse motion of the newly born ions is rapidly thermalized. The second mechanism is that of cyclotron resonance scattering by the intrinsic magnetic field fluctuations in the solar wind. The second mechanism was shown to be important for scattering the He^+ ions into the bulk motion of the wind. (JCW)

15702 RECENT STUDIES OF MAGNETOSPHERIC ELECTRIC FIELD EMISSIONS ABOVE THE ELECTRON GYROFREQUENCY. Fredricks, R. W.; Scarf, F. L. (TRW Systems Group, Redondo Beach, CA). J. Geophys. Res.; 78: No. 1, 310-314(1 Jan 1973).

A survey of vlf electric-field observations in the magnetosphere made with the short electric dipoles aboard OGO 5 was reviewed. The survey, made by Kennel et al., suggested that the predominant emissions were those at odd half-integral multiples of the local electron gyrofrequency f_{cc} and that, among these multiples, emissions at $f \approx 3f_{cc}/2$ were by far the most common, although other multiples, including $f_{cc}/2$, were also observed at times. Kennel et al. (1970) noted that the waves have large electric-field amplitudes (1 to 10 mV/m), and they suggested that $3f_{cc}/2$ emissions could be important sources of turbulent energization and pitch-angle diffusion for auroral-zone electrons. After surveying work by Holzer and Sato (1972) and Scarf et al. (1973), an expansion of the observational material of Kennel et al. was made. New observations are reported of emissions recorded by the plasma-wave detector in the 1- to 22-kHz analog channel for the period Oct. 17, 1970 to April 10, 1971. Results indicate (from Nov. 20, 1970 trace) that the more intense $3f_{cc}/2$ emissions are generally associated with proximity to the geomagnetic equator and local midnight; the most intense and persistent signals are detected at the base of the plasma sheet. (JCW)

15703 COMPOSITION OF RADIATION RECORDED BELOW THE RADIATION-BELT REGION AT MIDDLE LATITUDES. Tsaplin, V. S.; Shavrin, N. I.; Savun, O. I. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 151-153(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 177-179(1972).

Cosmos-137 and Cosmos-143 measurements are used to determine the composition of residual radiation (with respect to the primary cosmic-ray background) recorded in the region of space characterized by the parameters $H \approx 200$ to 300 km, $\varphi = 20$ to 40°, $L = 1.1$ to 1.7, and $B = 0.25$ to 0.4 gauss ($h_{min} < 0$). (auth)

15704 POSSIBILITY OF DETERMINING THE SOLAR COSMIC-RAY SPECTRUM AND GEOMAGNETIC CUTOFF RIGIDITY FROM IONOSPHERIC DATA. Dorman, L. I.; Krupitskaya, T. M. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 154-157(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 180-183(1972).

A method is described for determining the solar cosmic-ray spectrum and geomagnetic cutoff rigidity from data on ionization rates at several heights in the lower ionosphere. (auth)

15705 CONVECTIVE MOTION OF A VISCOUS, CONDUCTIVE FLUID IN THE REGION OF A ROTATING MAGNETIZED SPHERE. Romashchenko, Yu. A. (Inst. of Cosmophysical Investigations and Aeronomy, Yakutsk, USSR). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 167-173(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 193-200(1972).

The problem of the behavior of an isotropic plasma (σ and η are constants) in the vicinity of a rotating magnetized sphere is solved. It is demonstrated that a boundary layer of variable thickness forms in the vicinity of the sphere and rotates with it as a single whole. It is also shown that an induced, stationary (!) electric field appears in this plasma and gives rise to meridional currents. The result of this is the appearance of an azimuthal magnetic field, which is localized in the transition zone between the boundary layer and the undisturbed plasma at a distance from the sphere. (auth)

15706 DYNAMICS OF AURORAL-PARTICLE INJECTION DURING SUBSTORMS. Zhulina, E. M.; Driatskii, V. M.; Shchuka, T. I.; (and others) (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 212-218(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 243-251(1972).

The space-time dynamics of the auroral-electron spectrum during several substorms in the Earth's magnetosphere is estimated from balloon data on bremsstrahlung x-rays in March–April 1968 ($L = 3.8$). The pattern of appearance and development of these substorms in absorption has been traced. A picture of the dynamics of auroral-particle injection in substorm periods is proposed. A close relation is found between x-ray bursts and an increase in absorption, according to riometer data. (auth)

15707 PRINCIPLE OF LEAST ENERGY OF THE MAGNETIC FIELD OF THE MAGNETOSPHERE. Obertz, P. (Inst. of Geophysics, Warsaw). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 244-248(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 280-284(1972).

It is demonstrated for a two-dimensional case that the energy of the magnetic field is minimal when the potential difference between neutral currents at the magnetosphere boundary reaches a maximum. (auth)

15708 DISTRIBUTION OF THE POTENTIAL OF A SPHERE WHOSE CONDUCTIVITY DEPENDS ON LONGITUDE (WITH APPLICATION TO THE PHYSICS OF THE MAGNETOSPHERE). Akkuratov, E. P.; Alekseeva, L. M.; Tverskoi, B. A. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 249-254(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 285-291(1972).

The distribution of the potential $v(\theta,\varphi)$ around a sphere whose tensor conductivity depends on the azimuth angle is studied. The eigenvalues and eigenfunctions of this problem are found by sepa-

ration of variables and the law of expansion in them is determined. The results can be used to solve electrodynamic problems of an ionosphere whose conductivity is much higher on the day than on the night side (for example, the problem of the spreading of a current from the auroral electrojet region). (auth)

15709 RADIO NOISE FROM A NONSTATIONARY GAMMA-QUANTUM SOURCE ACCOMPANYING A GEOMAGNETIC FIELD DISTURBANCE. Medvedev, Yu. A.; Stepanov, B. M.; Fedorovich, G. V. Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 255-259(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 291-295(1972).

The amplitude-time characteristics of an electromagnetic signal accompanying a geomagnetic field disturbance produced by a nonstationary γ-quantum source are estimated. (auth)

15710 FORMATION OF THE BELT OF DR CURRENTS. Zaitseva, S. A.; Glazhevska, A. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 260-263 (1972).

Translated from Geomagn. Aeron.; 12: No. 2, 296-300(1972).

The mechanism of formation of the belt of DR currents is investigated. The equatorial trajectories of charged particles, initially located in the tail of the magnetosphere at L = 14, are computed for the condition μ = const and periodic turning "on" and "off" of a homogeneous electric field directed from the morning to the evening side of the Earth. (auth)

15711 PARTICLE DIFFUSION ACROSS A MAGNETIC FIELD UNDER THE EFFECT OF LARGE-SCALE HYDROMAGNETIC TURBULENCE. Toptygin, I. N. (Leningrad Polytechnic Inst.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 289-291 (1972).

Translated from Geomagn. Aeron.; 12: No. 2, 320-330(1972).

The mechanism that provides for effective diffusion determination across the magnetic field H_0 is the vibration of the lines of force of the resultant large-scale magnetic field. The resultant field consists of H_0 and of that part of the random field that corresponds to harmonics with wave number $k < R^{-1}$. The scale of variation of this field is greater than Larmor radius R and, therefore, the guiding center of the particles is associated in the first approximation with a line of force and wanders at random with it in the transverse direction. The order of magnitude of the transverse diffusion coefficient is easily estimated for characteristic limiting cases. (JCW)

15712 ESTIMATE OF ELECTRIC FIELDS IN THE EARTH'S MAGNETOSPHERE. Kuznetsov, S. N. (Moscow State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 314-316(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 354(1972).

It is found that for the same B the intensity of electrons is the same on the morning and evening sides of the same small L. Starting from some L_m shell, electron intensity becomes higher on the morning than evening side. This phenomenon can be explained in the framework of the theory of charged-particle acceleration in crossed electric and magnetic fields, (Alfven and Felthammar, 1967). A discussion is given to estimate the value of the electric field from the magnitude of this minimal L_m at which an increase in electron intensity on the morning side is observed. The investigation specifically used the monoenergetic electrons with E_e = 35 keV, instead of the entire spectrum of electrons with $E_e > 35$ keV for the relatively soft electron spectra recorded in the plasma sheet of the magnetotail, (Bame et al., J. Geophys. Res., 1967). Values of the electric field obtained by Wescott et al., (J. Geophys. Res., 1969) from experiments with barium clouds under disturbed conditions agree, when converted to the equatorial plane, with the maximum estimates made. The estimates of the electric field under magnetically quiet conditions exceed by a factor of 2 to 3 the estimates by McDiarmid and agree with those of McDiarmid, Burrows, and Wilson and agree with those of Roderer and Hones. (JCW)

15713 THREE-DIMENSIONAL HYDROMAGNETIC DISTURBANCES GENERATED BY A MAGNETIC DIPOLE IN AN ANISOTROPIC PLASMA. Van'yan, L. L.; Lipatov, A. S. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 316-318(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 355-356(1972).

The wave phenomena produced by a harmonic magnetic dipole perpendicular to the external magnetic field have not been investigated, but an analysis was made of the main characteristics of this phenomena. The components of the field are computed and it is noted that, unlike the case of a magnetic dipole parallel to B_0, both isotropic magnetoacoustic and directional hydromagnetic waves appear. Only the latter survive at a distance from the source. The amplitude of the transverse magnetic field does not decrease with distance along the lines of force of the main field and increases in proportion to frequency. This indicates its induced origin and essentially distinguishes the model in question from the field of an electric dipole. It can be assumed that the phenomena will be useful for the analysis of the propagation in the magnetosphere of hydromagnetic waves whose sources are current eddies at the magnetosphere boundary. (JCW)

15714 CHARACTERISTICS OF MAGNETIC DIPOLE EMISSION IN A PLASMA WITH FINITE CONDUCTIVITY. Van'yan, L. I.; Lipatov, A. S. (Inst. of Space Research, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 319-320(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 357-358(1972).

A transverse magnetic dipole excites both magnetoacoustic and directional hydromagnetic waves in an ideally conducting cold plasma. In this case, the directional inhomogeneous wave has a singularity directly on the line of force crossing the dipole. This phenomena was previously established by Van'yan and Lipatov, (Geomag. aeron., 11: 355(1972)). Characteristics of the wave phenomena of the transverse magnetic field in a plasma with finite conductivity was investigated. Results are discussed with relation to the behavior of the ideal plasma. (JCW)

15715 DYNAMICS OF INNER BOUNDARY OF PLASMA SHEET IN TAIL OF MAGNETOSPHERE DURING SUBSTORMS. Fel'dshtein, Ya. I. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 321-323(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 359-361(1972).

The position of the inner boundary of the plasma sheet in the magnetotail during various substorm phases is determined from the dynamics of the southern boundary of the auroral oval from work performed by G. V. Starkov and Ya. I. Fel'dshtein. The equatorial boundary of the auroral oval coincides with the projection along real magnetic lines of force of the inner boundary of the plasma sheet in the tail onto the heights of the ionosphere. The close agreement found both for individual crossings of the inner boundary of the plasma sheet by satellite and from a statistical comparison permits using data on the dynamics of the auroral oval in various phases of substorm development to estimate quantitatively the location of the plasma sheet during a substorm. The position of the auroral oval is known in sufficient detail in all sectors of LT and in various substorm phases, but there are very few satellite investigations of the dynamics of the plasma sheet. (JCW)

15716 QUASI-STATIONARY PINCH EFFECT AND STRUCTURE OF MAGNETOSPHERE. Raspopov, O. M.; Koshelevskii, V. K. (Leningrad State Univ.). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 323-325(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 362-364(1972).

The characteristics of the pinch effect in the magnetospheric plasma are analyzed and its influence on the formation of the structure of the magnetosphere is investigated. The parameters affecting the development of the pinch effect are discussed. Experimental data are reviewed that support the development of the pinch effect. Electron fluxes with an intensity $\geq 10^7$ cm^{-2} sec^{-1} that are parallel to geomagnetic lines of force can give rise to the development of a pinch effect and to the formation of the filamentary structure of the magnetosphere. The appearance of spatially limited auroral formations of the cellular structure of longitudinal currents can be interpreted. The development of the pinch effect determines the dimensions of plasma inhomogeneities in the equatorial plane of the magnetosphere also. The experimentally observed dimensions of "electron islands" agree well with the computed data. At the same time, the pinch effect in the magnetosphere does not influence significantly the focusing of proton beams. (JCW)

15717 SPECIAL FORM OF GEOMAGNETIC PULSATIONS. Kanonidi, Kh. D. (Inst. of Terrestrial Magnetism, Ionosphere, and Radio Wave Propagation, Moscow). Geomagn. Aeron. (USSR) (Engl. Transl.); 12: No. 2, 326-327(1972).

Translated from Geomagn. Aeron.; 12: No. 2, 365(1972).

A new form of short-period geomagnetic field intensity variations of a period of 5 to 10 sec was discovered with a gradually increasing and then decreasing amplitude. The form of variations appears first at lower latitudes and then moves to high latitudes. The amplitude of the variations decreases with increasing latitude. Another characteristic feature is that these short-period variations are observed in all three geomagnetic field components, which is not true of other variations of the same period. It is unusual that no noticeable effect is observed in terrestrial currents as observed at Shatsk, Borok, and Niemegk stations. An analysis is made of the four events of this kind observed on Nov. 13, 1965; July 22, 1967; Feb. 19, 1968; and March 28, 1970. (JCW)

15718 ADIABATIC MOTION IN A CHARGED PARTICLE TRAP. Byrne, J. (Univ. of Sussex, Brighton, Eng.). Proc. Roy. Soc. Edinburgh, Sect. A; 70: 47-61(1972).

The adiabatic invariants associated with the motion of charged particles, trapped in electromagnetic fields with rotational and reflection symmetry, were studied using classical methods based on the Hamilton–Jacobi equation. It was shown that results, valid for trapping in purely magnetic configurations, may be applied in the analysis of electromagnetic charged-particle traps, provided that suitably modified expressions are used for the angular frequencies in the various dynamical modes. Attention is drawn to circumstances in which the adiabatic conditions may be violated because of cancellation of electric and magnetic terms in the equations. (auth)

15719 GEOMAGNETIC VARIATIONS WITH THE PERIOD OF A SIDEREAL DAY. Malin, S. R. C. (Inst. of Geological Sciences, Herstmonceux, Eng.). Planet. Space Sci.; 21: No. 1, 145-146(Jan 1973).

Recent determinations of sidereal-day variations in the geomagnetic field have been attributed to galactic sources of ionization. Alternative mechanisms that could equally well account for the observed variations are presented, based on solar and lunar tides. (auth)

15720 LUNAR AND SOLAR GEOMAGNETIC TIDES IN DECLINATION AT ALIBAG. Rao, K. S. R.; Reddy, S. J.; Rao, K. N. (Meteorological Office, Poona, India). J. Atmos. Terrest. Phys.; 35: No. 2, 255-262(Feb 1973).

The solar and lunar geomagnetic tides in declination at Alibag have been determined by spectral analysis of discrete Fourier transforms following the method of Black (Phil. Trans. R. Soc. Lond., A268: 233(1970)) and by the well-known Chapman–Miller method. Larger amplitude of $L_2(D)$ in the j-season and smaller one in the d-season, contrary to the seasonal variation of the amplitude of $L_2(H)$, suggests that the seasonal behavior of the meridional component of the tidal force is different from that of the zonal component. The total L(D) and S(D) fields have different sunspot cycle enhancements, due to the interaction of the primary and secondary induced currents; but the principal harmonics $L_2(D)$ and $S_1(D)$ have the same order of enhancements indicating that the location of L and S dynamo currents are in the same layer of the ionosphere. The enhancements in the amplitudes of $S_1(D)$ and $L_2(D)$ due to increased magnetic activity are greater than the enhancements due to sunspot cycle by two orders of magnitude. It is suggested that low-latitude DS currents which are return currents of the DP activity in the high latitude contribute to the large enhancements. (auth)

15721 OBSERVATION OF THE REGION OF INTERACTION BETWEEN THE SOLAR-WIND PLASMA AND MARS. Vaisberg, O. L.; Bogdanov, A. V.; Borodin, N. F.; (and others). Cosmic Res. (USSR) (Engl. Transl.); 10: No. 3, 417-18(1972).

Translated from Kosm. Issled.; 10: No. 3, 462-3(1972).

The spacecraft Mars 3 began orbiting Mars Dec. 2, 1971. An analysis of the Mars-3 data is used to investigate the flow of solar wind past the planet. The energy spectra was measured in the plasma during varying heights of the spacecraft orbit from 1300 to 200,000 km. A regular occurrence of ions with energies of 30 to 140 eV were observed on orbits closest to Mars and accompany a decrease in the flux of ions with energies above 500 eV. These changes correspond to a variation in the plasma-flux velocity of ≈200 km/sec. Abrupt variations occur in the ion energy spectra that accompany the appearance of fluxes of particles with 140-eV energy. The ion energy spectra are similar to the energy spectra observed behind a shock wave in the Earth magnetosphere where there are particles with E = 140 eV. The energy spectrum of protons less than 140 eV near Mars is a weak-proton band observed at greater distances than the ion spectra and with increasing distance from the subsolar point. The outer boundary of this band does not maintain a fixed position. Sometimes the repeated appearance of low-energy particles is observed outside the zone, confirming the oscillations outside the boundary. (JCW)

15722 SIDEBAND INSTABILITY OF ELECTROSTATIC WAVES IN AN INHOMOGENEOUS MEDIUM. Nunn, D. (Imperial Coll. of Science and Tech., London). Planet. Space Sci.; 21: No. 1, 67-88(Jan 1973).

Resonant-particle excitation of two electrostatic waves with closely spaced wave numbers is studied, when there is an inhomogeneity present in the form of a spatially dependent wave number. Resonant-particle behavior in such a field is investigated, and the resonant-particle current is computed for a variety of cases. If the inhomogeneity is such that resonant particles see the wave numbers of the waves increasing, then it turns out that the wave of greatest wave number is preferentially amplified. If the gradient is reversed, it is the opposite wave that grows. Thus, when a narrow-band electrostatic wave is subject to beam excitation, only one of the sideband waves is unstable. The theory is applied to the closely analogous problem of sideband formation in the case of triggering of vlf emissions by magnetospheric whistler pulses and seems to account for much of the observed behavior. (auth)

15723 OBSERVATIONS OF LOW-ENERGY PROTONS WITH THE MOLNIYA 1 SATELLITE IN JULY–AUGUST, 1970. Vernov, S. N.; Borodulin, V. P.; Panasyuk, M. I.; (and others). Cosmic Res. (USSR) (Engl. Transl.); 10: No. 3, 340-4(1972).

Translated from Kosm. Issled.; 10: No. 3, 376-81(1972).

Measurements are reported of low-energy protons in the Earth's radiation belts during July–August, 1970, with the Molniya-1 satellite. The protons were recorded with a semiconductor detector equipped with a magnetic filter in three differential channels bounded successively by E_p = 130, 250, 340, and 420 keV, and in an integral channel, E_p > 420 keV. An analysis is made of the space distribution and spectrum of the protons in the four energy intervals during a period of relatively quiet magnetic conditions. The results are compared with previous experiments. (auth)

15724 ANNUAL AND SEMI-ANNUAL VARIATIONS IN THE ELECTRON DENSITY OF THE INNER MAGNETOSPHERE DEDUCED FROM WHISTLER DISPERSION. Hayakawa, M.; Ohtsu, J. (Nagoya Univ., Toyokawa, Japan). J. Atmos. Terrest. Phys.; 35: No. 2, 339-345(Feb 1973).

The annually and semiannually varying components in the electron density of the inner magnetosphere are studied by using the solar-cycle dispersion data of whistlers observed at low-latitude stations in Japan, Wakkansi (35.3°N geomagnetic lat.) and Moshiri (34.0°N). The amplitude and phase of varying components are investigated by the method of harmonic analysis. It is found that the time of occurrence of maximum in the variation of annual component is early February at night and early January at day. The maxima in the variation of semi-annual data take place in late January and July at night, and in late March and September at day. These are new findings peculiar to the density variation of the inner magnetosphere that are significantly different from the high-latitude results. The superposition of such annual and semiannual variations and annual mean in the electron density of the inner magnetosphere results in the observed annual curve of dispersion value, which shows maxima in spring and autumn, and minima in summer and winter. (auth)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstract 16439.

15725 (FOA-2-2579-E-8) HIGH INTENSITY PULSED ELECTRON BEAM SYSTEM. Mattsson, A. (Forsvarets Forskningsanstalt, Stockholm (Sweden)). Nov 1972. 11p. Dep. NTIS (U. S. Sales Only).

The design and performance of a high-intensity pulsed electron beam system, operating at 600 kV, is discussed. The emitted peak current is 5.7 kA, the pulse length 25 ns, and the calculated dose rate 3.6×10^{14} rad/s. (auth)

15726 (N-72-27763) HYDROGEN AS AN ATOMIC BEAM STANDARD. Peters, H. E. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jun 1972. 14p. (NASA-TM-X-65932; X-524-72-210). NTIS.

After a preliminary discussion of feasibility, new experimental work with a hydrogen beam is described. A space-focused magnetic resonance technique with separated oscillatory fields is used with a monochromatic beam of cold hydrogen atoms which are selected from a higher-temperature source. The first resonance curves and other experimental results are presented. These results are interpreted from the point of view of accuracy potential and frequency stability, and are compared with hydrogen maser and cesium beam capabilities. (auth)

15727 INFLUENCE OF LONGITUDINAL MAGNETIC FIELD ON A HIGH FREQUENCY ION SOURCE PERFORMANCES. Moraru, Doina; Botez, D. Stud. Cercet. Fiz.; 24: No. 9, 1061-1068 (1972). (In Rumanian).

The experimental data obtained by optical measurements on the plasma of the hydrogen high-frequency discharge in a longitudinal magnetic field, at pressure of $\sim 10^{-2}$ mm Hg, and by measurements on the current of ions extracted from plasma are presented. From the measurements it is determined that the magnetic field effect on the discharge, excited by an alternating field presenting a certain number of harmonics, is a resonant increase of the ion density in plasma, similar to that determined by the hf oscillator. No influence of the magnetic field on the ion extraction system was observed. The magnetic field application may determine an increase of the ion current extracted from the analyzed source from 0.55 to 1.15 mA, for about the same total power used and at the same gas flow. (auth)

15728 VIBRATIONAL EXCITATION IN CO BY ELECTRON IMPACT IN THE ENERGY RANGE 10 to 90 eV. Chutjian, Ara (California Inst. of Tech., Pasadena); Truhlar, D. G.; Williams, Walter; Trajmar, Sandor. Phys. Rev. Lett.; 29: No. 24, 1580-3(11 Dec 1972).

The ratio of the scattering intensity for the $v'' = 1$ excitation to the elastic scattering intensity at 40 and 80° scattering angles has been determined for 10- to 90-eV impact energies for electron scattering by CO. These ratio curves exhibit broad peaks near 20-eV impact energy that cannot be accounted for by plane-wave calculations based on potential scattering models. The peaks are indicative of a resonant excitation process (or processes) in the $v'' = 1$ channel in the range 15 to 25 eV. (auth)

15729 NEAR-THRESHOLD POLARIZATION OF THE $6^1S_0-6^3P_1$ LINE OF MERCURY EXCITED BY ELECTRON IMPACT. Ottley, T. W.; Denne, D. R.; Kleinpoppen, H. (Univ. of Stirling, Scotland). Phys. Rev. Lett.; 29: No. 25, 1646-8(18 Dec 1972).

New measurements of the polarization of the $6^1S_0-6^3P_1$ (2537-Å) line of mercury are presented for electron-impact energies between threshold at 4.9 and 8.0 eV. A large negative threshold polarization is indicated that falls to zero within a few tenths of an eV, rising again to maximum of −46% at 6.5 eV. Correlation of structure in the polarization and excitation functions suggests a compound-ion formation. (auth)

15730 PHYSICAL PROCESSES INVOLVED IN THE DISCHARGE TAKING PLACE IN A RECENTLY DEVELOPED ION SOURCE: THE TRIPLASMATRON. Aubert, Jean; Gautherin, Guy; Lejeune, Claude (Paris Univ., Orsay, France). Compt. Rend., Ser. B; 275: No. 15, 537-40(9 Oct 1972). (In French).

Analysis of the properties of electric discharges in a duoplasmatron suggested the development of a new discharge structure for negative and positive ion sources. The physical processes involved in these ion sources (called triplasmatrons) are presented. (France)

15731 SCATTERING OF ATOMS FROM SURFACES. THE ONE-PHONON CONTRIBUTION. Beeby, J. L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 5: No. 24, 3438-56(12 Dec 1972).

A quantum-mechanical theory is presented for the scattering of atoms from a crystal surface. The surface is represented by a moving, infinitely repulsive potential. A formal theory is presented that enables the scattering cross section to be evaluated, in principle, to all orders in the surface displacement. This is illustrated by evaluating the one-phonon scattering for He on Ag, showing that the experimental results cannot be explained by these one-phonon terms. (auth)

15732 EFFECT OF EXCHANGE BY ELECTRONS OF A METAL SURFACE ON THE ION SCATTERING COEFFICIENT. Khashimov, N. M. (Physical-Technical Inst., Dushanbe, USSR). Dokl. Akad. Nauk Tadzh. SSR; 15: No. 10, 24-8(1972). (In Russian).

The dependence of the scattering coefficient on the energy of bombarding negative ions Cl^- and Br^- for pure target surfaces of Tl, Mo, W, and Pt was determined. The relationship of the scattering coefficient to the quantity $(\phi - S_i)$ was studied, where ϕ = the work function of the target material, and S_i = the electron affinity of the incident ion. The results are contrasted with similar data on the alkali metal positive ions K^+, Rb^+, Cs^+, and Na^+. (KSW)

15733 SCATTERING OF ATOMS FROM SURFACES. 2. THE TWO-PHONON TERMS. Beeby, J. L. (Atomic Energy Research Establishment, Harwell, Eng.). J. Phys., C (London); 5: No. 24, 3457-61(12 Dec 1972).

An approximate calculation is presented for the two-phonon scattering of atoms from surfaces. This scattering lies essentially on top of the one-phonon scattering and does not spread to form a background. (auth)

15734 THEORY OF INELASTIC SCATTERING OF SLOW ELECTRONS BY LONG-WAVELENGTH SURFACE OF OPTICAL PHONONS: MULTIPHONON PROCESSES. Evans, E.; Mills, D. L. (Univ. of California, Irvine). Phys. Rev., B; 7: No. 2, 853-68(15 Jan 1973).

A quantum-mechanical theory is described of the inelastic scattering of low-energy electrons by multiphonon processes, from the surface of a semi-infinite crystal. A model introduced in an earlier paper is also employed in this work. The model describes the interaction of an incident low-energy electron with surface optical phonons by means of the macroscopic electric field set up outside the crystal by the ion motion. The model may be used to describe scattering either from ionic crystals, such as ZnO, or from nonionic crystals. An explicit expression is found for the wave function of the outgoing electron, and an expression is found for the probability that n phonons are created or absorbed in the scattering process. Two cases are considered. First the cross section for scattering off thermal phonons is examined, and second from a coherent surface wave excited by external means. For the first case, the result agrees with the earlier semiclassical theory of Lucas and Sunjic. However, the model is more general than theirs, since it is fully quantum mechanical. It is shown explicitly that the energy-loss cross section is proportional to the intensity of the specular beam, for scattering off both ionic and covalent crystals. For the second case (scattering from surface optical phonons generated coherently by an external source), we obtain a closed expression for the cross section. The physical origin of differences between the expressions is discussed. (auth)

15735 PRODUCTION OF $^{14}N^{7+}$ ION BEAMS. Apard, P. (CEN, Grenoble, France); Geller, R.; Jacquot, B.; Jacquot, C.; Bliman, S. Compt. Rend., Ser. B; 275: No. 17, 621-624(23 Oct 1972). (In French).

Preliminary results concerning the MAFIA 7+ experiment are presented. In the ion source, plasma electrons are accelerated up to the gyromagnetic resonance. Multicharged ions are created by single shake-off type collisions and by Auger cascades. N^{7+} ions are observed. (France)

15736 PHOTON TIME CORRELATIONS IN ION BEAMS. Camhy-Val, C.; Dumont, A. M. (Observatoire de Paris, Meudon, France). Compt. Rend., Ser. B; 275: No. 17, 625-627(23 Oct 1972). (In French).

The photon time correlation method can be used for ion lifetime measurements in ion beams, perturbations by cascades being avoided. (France)

15737 EFFICIENCY OF ION FOCUSING OF INTENSE ELECTRON BEAMS OF SHORT DURATION. Levin, V. M.; Prudnikov, I. A.; Rumyantsev, V. V.; Rybas, K. P.; Telepaev, B. N. (Scientific Research Inst. of Electrophysical Equipment,

Leningrad). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 475-477(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 146-148 (1972).

The possibility of ion focusing of an electron beam with a current of 300 A in a pulse at a voltage of 100 kV and a pulse length of 0.12 μs was investigated. A pressed porous oxide–nickel cathode 50 mm in diameter was used as the emitter. It is shown that the intense ion focusing of an electron beam having the indicated duration is observed in the pressure range 5×10^{-3} to 1.3×10^{-2} torr. Under these conditions no reduction of cathode emission is observed in the pressure range 5×10^{-6} to 1.3×10^{-2} torr. (2 figures) (auth)

Atomic and Molecular Properties

Refer also to abstracts 16193, 16397, 16399, 16434, 16470, and 16485.

15738 COLLECTIVE EFFECTS IN SPONTANEOUS EMISSION BY TWO ATOMS. Smirnov, D. F.; Sokolov, I. V.; Trifonov, E. D. (Leningrad State Univ.). Zh. Eksp. Teor. Fiz.; 63: No. 6, 2105-12(Dec 1972). (In Russian).

Collective spontaneous emission by two excited atoms located at an arbitrary distance from each other is investigated. The frequency and angular dependences of the radiation and its integral intensity as a function of time are obtained. Special attention is paid to interference effects. The effect of energy splitting and Coulomb interaction on the collective features of the emission spectrum is discussed. (auth)

15739 ENERGY SPECTRUM OF THE HYDROGEN ATOM IN A STRONG MAGNETIC FIELD. Smith, E. R.; Henry, R. J. W.; Surmelian, G. L.; O'Connell, R. F.; Rajagopal, A. K. (Louisiana State Univ., Baton Rouge). Phys. Rev., D; 6: No. 12, 3700-3701 (15 Dec 1972).

The energy spectrum for the 14 lowest states of the hydrogen atom in a strong magnetic field B is obtained. Emphasis is placed on values of $B \approx 10^6$ to 10^8 G, characteristic of those found in magnetic white dwarfs. The results for the ionization energy of the ground state are significantly better than those of Cohen, Lodenquai, and Ruderman for fields $\lesssim 7 \times 10^{11}$ G. (auth)

15740 SINGLET–TRIPLET MIXING IN HELIUM. Krause, D. Jr. Amherst, MA; Univ. of Massachusetts (1972). 144p. University Microfilms Order No. 72-33,003.

Thesis.

Experiments which have been used to explore the breakdown of the LS coupling scheme in the excited states of helium are discussed. In the Russell–Saunders (LS) description of the excited states of helium, proton excitation of triplet states is forbidden; i.e., $\Delta S = 1$ transitions are not allowed. However, the spin–orbit interaction for the two electrons in helium mixes the spin states. Thus, there is a small singlet component in the triplet-state wavefunction. The square of the small singlet–triplet mixing parameter $\gamma(3\,^3X)$ (where X refers to the orbital angular momentum states S, P, or D) is equal to the ratio of the proton excitation cross sections to corresponding triplet and singlet states, i.e., $\gamma^2(3\,^3X) = \sigma_p(3\,^3X)/\sigma_p(3\,^1X)$. If $\gamma^2(3\,^3X)$ is to be interpreted as the square of the singlet–triplet mixing coefficient, then this ratio of proton cross sections must be independent of the energy of the incident proton beam. In these experiments the direct proton excitation cross sections σ_p were not measured, but instead the apparent cross sections due only to proton excitation Q_p were measured. If the ratio of the proton apparent excitation cross sections $Q_p(3\,^3X)/Q_p(3\,^3X)$ is designated by $\beta^2(3\,^3X)$, then $\beta^2(3\,^3X) = \gamma^2(3\,^3X) + [\text{cascade contributions}]$. The results for $\beta^2(3\,^3X)$ for the n = 3 states of helium are as follows: $\beta^2(3\,^3S) = 0 \pm .0002$, $\beta^2(3\,^3P) = .0028 \pm .0007$, and $\beta^2(3\,^3D) = .06 \pm .014$. These values are in fact constant, within experimental error, in the energy range of the experiment. Further evidence for the breakdown of LS coupling in helium is provided by measurements of the effect of excitation transfer on the population of the $3\,^3D$ state of helium. Excitation transfer occurs when directly excited atoms are hit by the flux of ground-state atoms and transfer their excitation to another state. The summation of the excitation transfer cross sections $\sigma_c(n)$ was measured for transfer from an $n\,^1P$ state to the corresponding $n\,^3F$ state times the branching ratio B_n for radiative cascade to the $3\,^3D$ state, and obtained $\Sigma B_n\sigma_c(n) = 2.2 \times 10^{-12}$ cm^2. This result may only occur, without violation of the Wigner spin rule, if the higher F states are highly mixed, a situation corresponding to $\gamma^2(n\,^3F) \sim 1$. (Diss. Abstr. Int., B)

15741 HYPERFINE-STRUCTURE STUDIES OF ^{3}He BY ZERO-FIELD QUANTUM BEATS. Tillmann, K.; Andrae, H. J.; Wittmann, W. (Freie Univ., Berlin). Phys. Rev. Lett.; 30: No. 5, 155-158(29 Jan 1973).

A new beam-velocity-independent data analysis is used in a zero-field quantum-beat measurement for the determination of the magnetic-dipole hyperfine-interaction constants of the $3\,^3P$ and $4\,^3P$ states of ^{3}He. (auth)

15742 ZERO-FIELD LEVEL-CROSSING RESONANCES IN OPTICALLY PUMPED $2\,^3S_1$ ^{4}He. Slocum, R. E. (Texas Instruments Inc., Dallas). Phys. Rev. Lett.; 29: No. 25, 1642-5(18 Dec 1972).

Parametric resonances associated with zero-field level crossings of the $2\,^3S_1$ level of ^{4}He were investigated using transverse optical pumping. A steady-state technique based on the n = 0, p = 0 resonance (Hanle effect) is used to measure spin-state lifetimes and determine the dependence of the thermal relaxation time on the state of the active helium discharge. The n = 0, p = 1 resonance is quite strong and suitable for measuring weak magnetic fields. A sensitivity of 1.0×10^{-8} G is demonstrated for this measurement technique. (auth)

15743 NOTE ON THE COEFFICIENTS CONNECTING THE STARK AND FREE-FIELD WAVE FUNCTIONS FOR THE HYDROGEN ATOM. Kulkarni, R. G. (Oklahoma State Univ., Stillwater). Nuovo Cim.; 12B: No. 2, 215-18(11 Dec 1972).

The group-theoretic meaning of Tarter's recent work on the coefficients connecting Stark and free-field wave functions of the hydrogen atom is discussed. (auth)

15744 MAGNETIC HYPERFINE SPLITTING IN THE CONFIGURATION $4f^7 6s6p$ OF Eu I. Krueger, H. D.; Lange, W. (Technische Univ., Hanover). Phys. Lett.; 42A: No. 4, 293-4(18 Dec 1972).

Experimental results on the hyperfine structure of the $z^8P_{\frac{9}{2}}$ and $z^8P_{\frac{7}{2}}$ levels are presented and discussed by use of intermediately coupled eigenfunctions. Configuration mixing with $4f^7(^8S)$ 5d6p and $4f^6(^7F)$ $5d6s^2$ is taken into account. (auth)

15745 ELECTRICAL AND OPTICAL MEASUREMENTS IN A PULSED HELIUM DISCHARGE. II. Vagner, S. D.; Kagan, Yu. M.; Slyshov, A. G. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 4, 345-7(Apr 1972).

Translated from Opt. Spektrosk.; 32: No. 4, 650-2(Apr 1972).

Measurements of the time dependence of the intensities of several lines of atomic helium were made. The intensities of the lines do not drop monotonically after cessation of the current pulse through the tube. After a rapid drop the intensity reaches a maximum and only then decreases. The maximum is reached for all lines approximately several microseconds after cessation of the pulse. The ratio of the intensity at the maximum to that at the breakoff increases in the lines of a given series as the principal quantum number of the emitting level increases. The dependence of this effect on the tube diameter and the discharge current was investigated. (auth)

15746 CALCULATION OF INNER SHELL IONIZATION ENERGIES AND E.S.C.A. SHIFTS. McWeeny, R.; Velenik, A. A. (Univ. of Sheffield, Eng.). Mol. Phys.; 24: No. 6, 1421-30(Dec 1972).

In the calculation of inner-shell ionization potentials, the Koopmans theorem is unsatisfactory owing to a large "relaxation" of the valence electron distribution, following the creation of an inner-shell "hole." The effects of this relaxation are studied, using a group-function formulation to analyze the energy into core and valence contributions. Applications to the lithium atom and the methane molecule indicate that relaxation effects can be large. The importance of these results in the interpretation of E.S.C.A. data is discussed. (auth)

15747 DISTRIBUTION FUNCTION FOR ANGULAR CORRELATION IN He- AND Be-LIKE IONS. Banyard, K. E.; Ellis, D. J. (Univ. of Leicester, Eng.). Mol. Phys.; 24: No. 6, 1291-6 (Dec 1972).

A distribution function for the interelectronic angle in atomic systems is suggested and examined for 2- and 4-electron ions. The correlated wave functions of Weiss and others were used to study the behavior and relative importance of angular correlation in the K and L shells. (auth)

15748 HYPERFINE STRUCTURE OF THE $4f^{12}5d6s^2$ AND $4f^{13}6s6p$ EVEN LEVELS OF Tm I. Camus, P. (CNRS, Orsay, France). J. Phys. (Paris); 33: No. 8, 749-54(Aug 1972). (In French).

The theoretical study of the hyperfine structure of the levels from the configurations $4f^{12}5d6s^2 + 4f^{13}6s6p$ allowed the interpretation of 27 previously measured A constants with an r.m.s. error of 1.6 mK. This error represents 9% of the average value of the A factors observed. The relativistic effective hamiltonian for the hyperfine structure described by Judd is introduced to show that the relativistic corrections are, in general, of the same order of magnitude as the experimental errors and are relevant for 7 val-

ues, accurately measured using the level-crossing method in an atomic beam. (France)

15749 APPLICATION OF MANY-BODY GREEN'S FUNCTIONS TO THE SCATTERING AND BOUND-STATE PROPERTIES OF HELIUM. Yarlagadda, B. S. (Univ. of Southern California, Los Angeles); Csanak, G.; Taylor, H. S.; Schneider, B.; Yaris, R. Phys. Rev., A; 7: No. 1, 146-154(Jan 1973).

The approximation scheme suggested by Schneider, Taylor, and Yaris is applied to the scattering and bound-state properties of the helium atom. Elastic scattering phase shifts for s, p, and d partial waves, ionization potentials, one-electron ground-state properties (i.e., electron densities, the natural orbitals, and the ground-state energy), and excitation energies from the ground to the excited states of helium were calculated simultaneously from the linear-response function and one-particle Green's function. This simultaneity is made possible by concentrating all computational effort on calculating the one- and two-particle amplitudes rather than on the ground- and excited-state wave functions. These amplitudes can be directly related to almost all the properties of physical interest in atomic and molecular systems. The results for both the scattering- and stationary-state properties are in good agreement with experiment and other previous calculations. (auth)

15750 ACCURATE THIRD-HARMONIC COEFFICIENT OF HELIUM. Klingbeil, R. (Univ. of Maryland, College Park). Phys. Rev., A; 7: No. 1, 48-50(Jan 1973).

The third-harmonic coefficient of an atom is obtained in terms of zeroth-, first-, and second-order wave functions. The results of an accurate variational calculation of the third-harmonic coefficient of helium is presented. The zero-frequency third-harmonic coefficient is 42.8 a.u. which is identical to the static hyperpolarizability obtained by Grasso, Chung, and Hurst. The $1s^2 \rightarrow 1s2p$ transition wavelength is determined to be 582 Å compared with the experimental result of 584 Å. (auth)

15751 EXCITED ELECTRONIC STATES OF O_2^-. Krauss, M. (National Bureau of Standards, Washington, DC); Neumann, D.; Wahl, A. C.; Das, G.; Zemke, W. Phys. Rev., A; 7: No. 1, 69-77 (Jan 1973).

Excited electronic states of the O_2^- molecule are calculated with configuration-interaction (CI) variational trial functions that assure formally correct asymptotic behavior as well as the single-configuration self-consistent-field (SCF) approximation. CI results were obtained by both multiconfiguration self-consistent-field (MC-SCF) and pseudonatural orbital (PNO) techniques. The MC-SCF results are most accurate and are used to analyze the energy curves and wave functions of these states for internuclear separations larger than 3 a.u. All the excited states are found to have equilibrium-internuclear separations at least 1 a.u. larger than the ground state. The two lowest energy states, the $^4\Sigma_u^-$ and $^2\Pi_u$, are characterized, respectively, as shape and valence Feshbach resonances. They are sufficiently bound to make it likely they play a role in low-energy-electron scattering by oxygen. (auth)

15752 MAGNETIC INTERACTIONS OF ONE-ELECTRON ATOMS AND OF POSITRONIUM. Grotch, H.; Kashuba, R. (Pennsylvania State Univ., University Park). Phys. Rev., A; 7: No. 1, 78-84(Jan 1973).

In earlier papers the magnetic moment of a hydrogenic atom in its ground state was calculated, including radiative and nuclear-mass corrections. In this work, the g_j and g_I factors are calculated for arbitrary hydrogenic states, including radiative and nuclear-mass corrections. The magnetic moment of a hydrogenic atom is obtained for any state. An extensive analysis of the Zeeman levels of positronium is carried out for the n = 1 and n = 2 states, including higher-order corrections. For the n = 1 state, the results confirm the validity of the Breit–Rabi formula with g factors in agreement with those given in an earlier paper by Grotch and Hegstrom. The annihilation diagram is included in the analysis but does not lead to any additional correction terms. The Zeeman corrections in the n = 1 state are relevant to the precise experimental determination of the positronium hyperfine structure. The analysis of the n = 2 state Zeeman structure of positronium is similar to that carried out by Brodsky and Parsons for the n = 2 states of hydrogenic atoms. Although the results in the hydrogenic case were immediately applicable to Lamb-shift measurements, the present results are not yet applicable since at present there is no experimental data on the excited state of positronium. (auth)

15753 MULTIPHOTON IONIZATION OF ATOMIC AND MOLECULAR HYDROGEN AT 0.53 μ. LuVan, M.; Mainfray, G.; Manus, C.; Tugov, I. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev., A; 7: No. 1, 91-98(Jan 1973).

Multiphoton ionization and dissociation of molecular hydrogen under the influence of laser radiation at 0.53 μ are studied. The six-photon ionization probability of hydrogen atoms is derived for laser radiation acting upon atomic hydrogen from a molecular hydrogen beam which is up to 80% dissociated by radio-frequency power. The experimental six-photon ionization probability of atomic hydrogen was found to be in good agreement with the corresponding probability calculated using time-dependent perturbation theory if the statistical properties of the incident light are taken into account. (auth)

15754 RESONANCE NATURE OF MULTIPHOTON IONIZATION OF THE HYDROGEN ATOM AND HYDROGEN-LIKE IONS. Parzynski, R. (Adam Mickiewicz Univ., Poznan, Poland). Acta Phys. Pol.; A42: No. 6, 745-7(Dec 1972).

The probability of multiphoton ionization can be of resonance nature even if resonance excitations and the intense laser field effect on energy structure are neglected. (auth)

15755 O(4) SYMMETRY AND HYDROGEN ATOM. Sredniawa, Bronislaw (Jagellonian Univ., Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 13-16(1969).

The energy levels of the hydrogen atom are calculated using the O(4) group. (JFP)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 15752, 15904, 15905, 16224, 16232, and 16451.

15756 (JINR–D1-6349, pp 349-92) REVIEW TALK ON MUONIC ATOMS. Wu, C. S. (Columbia Univ., New York).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

This review article discusses the following aspects of muonic atoms: (1) dynamic aspects of muonic atoms, (2) the effects of 1s muon on the de-excitation nuclear γ rays, (3) the vacuum polarization correction, (4) M1 hyperfine structure, (5) the isotone effects, (6) E2 radiative transitions, and (7) the model independent parameters of the nuclear charge distribution. (73 references). (MOW)

15757 (JINR–D1-6349, pp 411-30) INVESTIGATION OF THE PROPERTIES OF MATERIALS BY MEANS OF POLARIZED MUONS. Gurevich, I. I. (Inst. of Atomic Energy, Moscow). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Muon methods of studying the properties of matter are based on the fact that the muons being arrested in a substance are labelled particles, the direction of spin of which may be followed by the asymmetry of the angular distribution of electrons of the $\mu \rightarrow e$ decay. The observation of free muons and meso-atoms, the existence of negative muons, and the kinetics of chemical reactions of muons are discussed. Dipole interactions of muons with nuclei and the related diffusion of μ^--mesons are considered. (KSW)

15758 EFFECT OF NUCLEAR MOTION ON THE ENERGY EIGENVALUES IN MUONIC ATOMS. Fricke, B. (Northwestern Univ., Evanston, IL). Phys. Rev. Lett.; 30: No. 4, 119-22 (22 Jan 1973).

The effect of the nuclear motion on the energy eigenvalues in muonic atoms was studied. In addition to the usually used reduced-mass correction, the relativistic influences including the magnetic and retardation interaction between the nucleus and the muon were calculated for the inner orbitals of muonic atoms. (auth)

15759 ANOMALOUS PARAPOSITRONIUM LIFETIME IN WATER AT 20°C. Patro, A. P.; Sen, P. (Saha Inst. of Nuclear Physics, Calcutta). J. Phys., C (London); 5: No. 23, 3273-8 (28 Nov 1972).

Parapositronium lifetime has been determined in water and heavy water at different temperature settings around 20°C using a fast time measuring set up with a prompt resolution ~200 ps and slopes of ~35 ps at the experimental side channel settings. The para lifetime, for all the cases except for water at 20°C, is the same (~0.125 ns) within errors as expected from theoretical predictions. At 20°C in water, the para component cannot be separated from the free annihilation component indicating that the para life is the same as the free annihilation lifetime. This is consistent with the swollen positronium concept as suggested by Goldanskii (1967) for explaining the magnetic quenching data for water at 20°C. (auth)

15760 IS THERE A NEED TO CALCULATE POSITRONIUM AND MUONIUM hfs TO HIGHER ORDER? Fulton, T. (Johns Hopkins Univ., Baltimore). Phys. Rev., A; 7: No. 1, 377-379 (Jan 1973).

An estimate of $\alpha^4 R_\infty$ contributions to positronium and muonium hfs is made in somewhat greater detail than heretofore. Comparison with the most recent experimental data suggests that such additional corrections could well improve agreement between theory and experiment. Indeed, the one immediately calculable $\alpha^4 R_\infty$ contribution almost totally accounts for present discrepancies. (auth)

15761 ELECTRON SCREENING IN MUONIC ATOMS. Vogel, P. (California Inst. of Tech., Pasadena). Phys. Rev., A; 7: No. 1, 63-69(Jan 1973).

Screening corrections to the muon binding energies are computed for Pb, Tl, Ba, and O. Available methods of calculation are compared. It is shown that in a broad range of atomic charges and muon states the screening of nuclear charge by the muon is almost complete, and therefore the electron density of the Z-1 element can be used in most applications. The effect of the muon on the electron cloud and the effect of the vacancies in electron shells on the screening corrections are calculated and discussed. The degree of ionization of the electron $1s_{\frac{1}{2}}$ orbit is determined by a cascade calculation including repopulation from the 2p shell. (auth)

15762 INVESTIGATION OF POSITRON ANNIHILATION IN AQUEOUS IRON(III) PERCHLORATE SOLUTIONS AT DIFFERENT pH'S. Goldanski, V. I. (Inst. of Chemical Physics, Moscow); Levay, B.; Shantarovich, V. P.; Ranogajec-Komor, M.; Vertes, A. Radiochem. Radioanal. Lett.; 12: No. 4-5, 289-293(20 Dec 1972).

Positron lifetime spectra were measured in aqueous iron(III) perchlorate solutions at different pH's. The reaction rate between positronium and the Fe^{3+} ion showed a significant decrease as the pH changed from 0.1 to 2.3. In the presence of chloride ions at pH = 2.3, the reaction rate increased slightly again. Correlation was found between positron-annihilation parameters and the electron exchange capacity of the system. (auth)

15763 OBSERVATION OF ELECTRIC QUADRUPOLE X-RAY TRANSITIONS IN MUONIC THALLIUM, LEAD, AND BISMUTH. Schneuwly, H.; Schellenberg, L.; Backe, H.; (and others) (CERN, Geneva). Nucl. Phys.; A196: No. 3, 452-64(1972).

Electric quadrupole X-ray transitions (5g → 3d, 4f → 2p, and 3d → 1s) have been observed in muonic Tl, Pb and Bi. From the 3 → 1 transitions, energy splittings of the n = 3 levels were deduced. From a comparison of the relative intensities of E1 and E2 transitions, the population ratios 5g/5f, 4f/4d, and 3d/3p were deduced. These ratios are well reproduced by a cascade calculation assuming a statistical initial population at n = 20, including K, L, and M shell conversion. In the case of ^{205}Tl discrepancies between the experimental and the calculated 3d-1s/3p-1s intensity ratio can be explained by nuclear excitation. From the $3p_{\frac{1}{2}} \rightarrow 1s_{\frac{1}{2}}$ intensity in ^{209}Bi we can deduce the ratio of the radiationless to the X-ray transition width and give limits for prompt neutron emission from the 3d level. (auth)

15764 NUCLEAR POLARIZATION AND CHARGE PARAMETERS USING THE MUONIC 2s STATE. Martin, P. Williamsburg, VA; Coll. of William and Mary (1972). 169p. University Microfilms Order No. 72-23,122.

Thesis.

Muonic x-ray transition energies have been determined in ^{120}Sn, ^{138}Ba, ^{140}Ce, ^{142}Ce and ^{206}Pb using a high efficiency Ge(Li) detector. Precise energy measurements, relative intensity measurements, and a comparison of energy splittings have made it possible to identify transitions to and from the 2s state in each of these targets. There is good agreement between theoretical and experimental relative intensities for these transitions, except for ^{206}Pb, where the experimental values are much smaller than expected, and the $3p\ ^1/_2$-2s transition could not be detected at all. These transition energies, together with those from the 2p-1s, 3d-2p and 4d-2p transitions are used to deduce sets of nuclear parameters. It has been found that for each target except ^{120}Sn, the best agreement between theory and experiment is obtained by applying the theoretical nuclear polarization corrections to all levels with n > 1, and allowing the nuclear polarization induced by the 1s muon to vary. The nuclear polarization values determined were 4.5 ± 3.0 keV for ^{120}Sn, 6.3 ± 1.3 keV for ^{138}Ba, 5.8 ± 1.2 keV for ^{140}Ce, 6.3 ± 1.4 keV for ^{142}Ce and 5.8 ± 2.0 keV for ^{206}Pb. These results are in good agreement with the most recent theoretical predictions It is concluded that nuclear polarization is an important effect and should be taken into account in muonic atoms. In addition, first forbidden electric quadrupole transitions have been detected in all targets except ^{120}Sn, and it is shown that these should be included in the muonic cascade to account for the measured relative intensities. (Diss. Abstr. Int., B)

Collision Phenomena

Refer also to abstract 15630.

15765 (N-72-26553) MEASUREMENT OF RELATIVE CROSS SECTIONS FOR SIMULTANEOUS IONIZATION AND EXCITATION OF THE HELIUM 4 2s AND 4 2p STATES. Sutton, J. F. (National Aeronautics and Space Administration, Greenbelt, Md. Goddard Space Flight Center). Jun 1972. 96p. (NASA-TR-R-378). NTIS.

The relative cross sections for simultaneous ionization and excitation of helium by 200-eV electrons into the 4 2s and 4 2p states were measured via a fast delayed coincidence technique. Results show good agreement with the relative cross sections for single electron excitation of helium and hydrogen. An application of the results of the measurement to the development of ultraviolet intensity standard is suggested. This technique involves the use of known branching ratios, a visible light flux reference, and the measured relative cross sections. (auth)

15766 (NP-19625) FREQUENCY DEPENDENCE OF THE Xe AND Kr ATOMS MULTIPHOTON IONIZATION. Alimov, D. T.; Berezhetskaya, N. K.; Delone, G. A.; Delone, N. B. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). 1972. 24p. (In Russian and English. Dep. NTIS (U. S. Sales Only).

The multiphoton ionization process was observed experimentally by the use of a Nd laser beam on Xe and Kr atoms. Emitted ion intensities were measured as functions of laser beam intensity at different frequencies. Frequency change measurements were made with two Fabry-Perot interferometers. A diagram shows the frequency dependent characteristics of the ionization process. (MOW)

15767 CROSS SECTIONS FOR THE EXCITATION OF THE 4^1S-, 4^1D-, AND 3^1P-LEVELS OF HELIUM EXCITED BY FAST He^+ IONS. Hasselkamp, D.; Hippler, R.; Scharmann, A.; Schartner, K. H. (Univ., Giessen, Ger.). Z. Phys.; 257: No. 1, 43-50(1972).

An experimental study was made of the excitation of the 4^1S, 4^1D and 3^1P levels of helium by fast He^+ ions in the energy range of 80 to 1100 keV. Absolute cross sections were obtained by normalization on proton-impact results. A pronounced broad maximum was found in the three excitation functions. The results are compared with proton-impact results of equal velocities. (auth)

15768 EXPERIMENTAL INVESTIGATION OF ArII AND KrII EXCITATION IN ELECTRON-ION COLLISIONS. Zapesochnyi, I. P.; Imre, A. I.; Dashchenko, A. I.; (and others) (Uzhgorod State Univ., USSR). Zh. Eksp. Teor. Fiz.; 63: No. 6, 2000-9(Dec 1972). (In Russian).

An arrangement with intersecting beams for investigation of ion excitation in electron-ion collisions is briefly described in which beams of relatively high concentration and a monochromator for spectral separation of the radiation are employed. Some features of the experiment and the measurement technique are considered in detail. Results on excitation of Ar II spectral lines from the $4p^2P^0_{\frac{1}{2}}$, $4p^2P^0_{\frac{3}{2}}$, $4p^4P_{\frac{1}{2}}$, $4p^2D^0_{\frac{3}{2}}$, $4p^2D^0_{\frac{5}{2}}$ levels and of the Kr II lines from the $5p^4P^0_{\frac{1}{2}}$, $5p^4P^0_{\frac{3}{2}}$, $5p^4D^0_{\frac{5}{2}}$, $5p'^2D^0_{\frac{5}{2}}$ and $5p'^2F^0_{\frac{7}{2}}$ levels are discussed. The most characteristic features of ion excitation by electron impact are interpreted. (auth)

15769 ASYMPTOTIC EXPRESSION FOR THE AMPLITUDE FOR INELASTIC SCATTERING OF FAST ELECTRONS BY HYDROGEN ATOMS. Potapov, V. S. (Moscow State Univ.). Zh. Eksp. Teor. Fiz.; 63: No. 6, 2094-2104(Dec 1972). (In Russian).

An angle-uniform asymptotic expression for the differential cross section for scattering with excitation and also for exchange scattering of fast electrons by hydrogen atoms is obtained in a second Born approximation for the transition amplitude. The formulas obtained are in good agreement with available experimental data for 1s → 2s,2p transitions in the hydrogen atom. An asymptotic expression is also obtained for the amplitude derived in the distorted-wave Born approximation. (auth)

15770 COLLISIONAL QUENCHING OF METASTABLE HYDROGEN ATOMS BY RARE GASES. Byron, F. W. Jr. (Univ. of Massachusetts, Amherst); Gersten, J. I. Phys. Rev. Lett.; 30: No. 4, 115-18(22 Jan 1973).

The collisional quenching of slow metastable hydrogen atoms by rare-gas targets is analyzed in the framework of a pseudopotential method. One finds that the experimental results of Kass and Williams are in full agreement with theory if the anomalously large elastic scattering is taken into account. (auth)

15771 PROJECTILE STRUCTURE EFFECTS ON NEON K X-RAY PRODUCTION BY FAST, HIGHLY IONIZED ARGON BEAMS. Mowat, J. R.; Pegg, D. J.; Peterson, R. S.; Griffin, P. M.; Sellin,

I. A. (Univ. of Tennessee, Knoxville). Phys. Rev. Lett.; 29: No. 24, 1577-9(11 Dec 1972).

An already large yield of neon K x rays produced by a high-energy (60 to 80 MeV) stripped argon beam has been observed to undergo a tenfold increase when the projectile charge state is changed from +6 (2p shell full) to ~+14 (2p shell empty). This increase may be understood qualitatively in terms of a transfer of 1s neon electrons to the empty 2p shell of the more highly stripped ions during collisions. Other possible interpretations are also discussed. (auth)

15772 ELECTRON TRANSMISSION SPECTROSCOPY IN ATOMIC HYDROGEN. Sanche, L.; Burrow, P. D. (Yale Univ., New Haven). Phys. Rev. Lett.; 29: No. 25, 1639-42 (18 Dec 1972).

An electron transmission experiment is used to study the resonances in the total scattering cross section of atomic hydrogen below the threshold of the first excited state. The three lowest resonances, designated ^1S, ^3P, and ^1D, are observed and their energies and decay widths are found to be in good agreement with the values predicted theoretically using close coupling with correlation. (auth)

15773 ELECTRON SHELLS IN OVER-CRITICAL EXTERNAL FIELDS. Mueller, Berndt; Rafelski, Johann; Greiner, Walter (Univ., Frankfurt am Main). Z. Phys.; 257: No. 1, 62-77(1972).

When the charge of a nucleus exceeds $Z = Z_{cr} \approx 164$ to 172 the energy of the 1s-electron level is lowered beyond the critical value of $-m_e c^2$. Then this bound level is degenerated with negative energy continuum solutions of the Dirac equation and becomes a resonance, whose shape varies and is approximately of Breit–Wigner type for $Z - Z_{cr} \gtrsim 5$. The physical meaning of this resonance can be understood most easily if the 1s level is unoccupied (K hole). In this case a positron may escape if $Z > Z_{cr}$, a process that can be interpreted as auto-ionization of the positron. This fundamentally new process of quantum electrodynamics of strong fields can be tested experimentally by scattering very heavy ions ($Z \leq 80$) on each other since, in such collisions, superheavy electronic molecules occur (superheavy quasimolecules). (auth)

15774 AUTO-IONIZATION OF POSITRONS IN HEAVY-ION COLLISIONS. Mueller, Berndt; Rafelski, J.; Greiner, W. (Univ., Frankfurt am Main). Z. Phys.; 257: No. 3, 183-211 (1972).

Autoionization of positrons occurs as a fundamentally new process of quantum electrodynamics, if empty 1s- or $2p_{\frac{1}{2}}$- etc. electronic shells obtain binding energies larger than $2m_e c^2$. This effect should be experimentally observable in the scattering of very heavy ions ($Z \geq 80$) on each other since in such collisions superheavy electronic molecules are formed (superheavy quasimolecules). The scattering mechanism and the distribution of autoionization positrons are discussed. The adiabaticity of the heavy-ion collision is studied and the electron–positron pair production background to the ionization problem is estimated. Analytic solutions are obtained for 1/r potentials for the case $Z\alpha \geq 1$. The phase shifts of negative energy solutions in the case of cut-off Coulomb potentials reveal the accuracy of the autoionization formalism. (auth)

15775 COMPARISON BETWEEN CROSSED-BEAM AND TARGET-GAS METHODS FOR STUDY ON OPTICAL EXCITATION FUNCTIONS IN ELECTRON IMPACT OF H_2O. Tsurubuchi, S.; Iwai, T.; Horie, T. (Osaka Univ.). J. Phys. Soc. Jap.; 34: No. 1, 166-71(Jan 1973).

The so-called "crossed-beam method" and "target-gas method" are applied to the same events of molecular collisions. It is shown that the former method gives reliable information about the excitation functions for the OH band and the Balmer lines in dissociative and radiative collisions of H_2O with electrons, while the latter does not, at least, in the range of lower energies of incident electrons. (auth)

15776 ZERO-FIELD QUANTUM BEATS IN LYMAN-α RADIATION SUBSEQUENT TO BEAM-FOIL INTERACTION OF PROTONS. Dobberstein, P. (Freie Univ., Berlin); Andrae, H. J.; Wittmann, W.; Bukow, H. H. Z. Phys.; 257: No. 3, 272-8(1972).

Zero-field quantum beats were observed in Lyman-α emission (1216 Å) from hydrogen atoms formed by beam–foil interaction of 50- to 270-keV proton beams. Relative excitation cross sections for magnetic substates of the 2P level of hydrogen were derived from modulation amplitudes and are discussed with respect to the excitation process. (auth)

15777 DIFFERENTIAL CROSS SECTION FOR THE INNER-SHELL IONIZATION OF MEDIUM-HEAVY ATOMS BY THE ELECTRONS. Das, J. N. (University Coll. of Science, Calcutta). Nuovo Cim.; 12B: No. 2, 197-204(11 Dec 1972).

A theoretical study of the differential cross section for the inner-shell ionization of medium-heavy atoms is made. Special attention is paid to the study of the angular distribution of the scattered electrons, scattered after ionizing a Sn atom, and to the momentum distribution of the electrons ejected from the atom. (auth)

15778 EXCITATION TRANSFER IN HELIUM. Bogdanova, I. P.; Marusin, V. D. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 6, 578-579(Jun 1972).

Translated from Opt. Spektrosk.; 32: No. 6, 1067-1070(Jun 1972).

The brightness of radiation of helium spectral lines from the 3^3D and 4^3D levels, caused by a process of additional occupation of these levels, was studied as a function of the energy of exciting electrons up to 100 eV. A difference is observed in the behavior of this dependence in comparison with the shape of the excitation function of the 3^1P level of helium. (auth)

15779 ELECTRON LOSS BY HELIUM ATOMS PASSING THROUGH INERT GASES AND MOLECULAR HYDROGEN, NITROGEN, AND OXYGEN. Tripathi, A. N.; Mathur, K. C.; Joshi, S. K. (Univ. of Roorkee, India). Phys. Rev., A; 7: No. 1, 109-112(Jan 1973).

The Born approximation and free-scattering model are used to calculate the electron-loss cross section from atomic helium incident on He, Ne, Ar, and Kr atoms and on H_2, N_2, and O_2 molecules. For the molecules, the phase difference between the scattered wave emanating from the two atoms was considered in the separated-atom approximation. The vibrational damping of the molecule is also taken into account. It is shown that the effect of phase is very small. (auth)

15780 COLLISIONAL QUENCHING OF METASTABLE HYDROGEN. Kass, R. S.; Williams, W. L. (Univ. of Michigan, Ann Arbor). Phys. Rev., A; 7: No. 1, 10-14(Jan 1973).

Measurements of the collisional quenching of the 2S state of atomic hydrogen by helium, neon, argon, and krypton were made. The energy range was in the thermal region ($v \sim 10^6$ cm/sec). The cross sections were determined by measuring the attenuation of a beam of H(2S) atoms in passing through targets of the various gases. Time-of-flight techniques were used to measure the velocity dependences of the cross sections. For an incident H(2S) velocity $\approx 1 \times 10^6$ cm/sec, the measured cross sections are σ(helium) = 81 ± 12 Å²/atom, σ(neon) = 80 ± 12 Å²/atom, σ(argon) = 91 ± 14 Å²/atom, and σ(krypton) = 108 ± 16 Å²/atom. The results for helium are 10 to 15% higher than theoretical results obtained by Slocomb, Miller, and Schaefer and 20 to 25% higher than a calculation by Byron and Gersten using a pseudopotential method. (auth)

15781 DETERMINATION OF THE H–He POTENTIAL FROM MOLECULAR-BEAM EXPERIMENTS. Gengenbach, R.; Hahn, C.; Toennies, J. P. (Univ., Bonn). Phys. Rev., A; 7: No. 1, 98-103 (Jan 1973).

Absolute total cross sections for D–He scattering were measured with an accuracy of 1% at 0.3, 0.5, and 0.6 eV. These new data were combined with published relative measurements of the velocity dependence of the H–He cross section in a χ^2 minimalization procedure. The resulting potential V(R) as function of internuclear separation R is precisely determined in the repulsive range 1.7 Å < R < R_0 with $V(R_0) = 0$. Several multiparameter potential models were tried. Of these the four-parameter ansatz $V(R) = A(e^{-\alpha R} - e^{-\alpha R_0})$ (for $R < R_0$) $= 4\epsilon[(R_0/R)^{12} - (R_0/R)^6]$ (for $R > R_0$) was found to describe the data best. Parameters obtained are A = 70.00 eV, α = 3.383 Å^{-1}, R_0 = 3.20 Å, and ϵ = 0.39 MeV. The well depth ϵ, to which the measurements are insensitive, is chosen to match the theoretical van der Waals constant C_6 = 2.83 a.u. The potential is compared with results of ab initio calculations, and a probable ϵ range is discussed. For $0.35 \lesssim \epsilon \lesssim 0.70$ MeV the calculated low-energy cross section shows a pronounced Ramsauer–Townsend minimum. The possibility of its observation is pointed out. (auth)

15782 TOTAL INELASTIC CROSS SECTION FOR COLLISIONS OF H_2 WITH FAST CHARGED PARTICLES. Liu, J. W. (Indiana Univ., Bloomington). Phys. Rev., A; 7: No. 1, 103-109(Jan 1973).

A sum rule due to Inokuti et al. for the Bethe inelastic cross section for fast-charged-particle collisions with atoms and molecules was applied to H_2. Using an accurate two-center configuration-interaction wave function, the formula for nonrelativistic incident particles was found to be given as $\sigma_{tot} = 4\pi a_0^2 z^2 (R/T)[1.5487 \ln(T/R) + 2.2212]$ to within an error of 0.5% in σ_{tot} for incident-electron energies above 1 keV. Although the theoretical values are in good agreement with the summed experimental (i) total ionization (including dissociation ionization), (ii) total dissociative excitation, and (iii) most important discrete excitation cross sections, an apparent systematic trend suggests that one or more of

the current experimental total cross sections for electron impact on H_2 may not be accurate and that omitted processes should be included for comparison in the incident energy range above 1 keV. (auth)

15783 EMISSION CROSS SECTIONS FOR THE N_2 SECOND POSITIVE (0,0) TRANSITION FOR H, H^+, He, AND He^+ IMPACT. Hoffman, J. M.; Lockwood, G. J.; Miller, G. H. (Sandia Labs., Albuquerque, NM). Phys. Rev., A; 7: No. 1, 118-125(Jan 1973).

Absolute emission cross sections for 3371-Å radiation resulting from $C\ ^3\Pi_u(v' = 0) \rightarrow B\ ^3\Pi_g(v'' = 0)$ transition in molecular nitrogen were measured for H, H^+, He, and He^+ projectiles. The energy range covered was from 10 to 100 keV for all projectiles except H^+, where the lower limit was 40 keV. Excitation of the $C\ ^3\Pi_u$ upper state requires a spin change, usually accomplished by interchange of electrons. Thus the cross section for H^+ impact is very small ($\lesssim 10^{-19}$ cm^2) and could not be measured reliably below 40 keV at this time. Some emission cross sections are presented for incident helium atoms in the $2\ ^3S$ metastable state. Comparisons are made of He^+ and H data, where the minimum excitation energy required is the same, and of He^+ and He data, where the minimum excitation energies are quite different. Cross sections are also presented for emission of the N_2^+ (3914-Å) band for protons in the 8 to 30 keV energy range, permitting comparison with the measurements of other investigators. (auth)

15784 TOTAL CROSS SECTIONS FOR CHARGE TRANSFER AND STRIPPING OF Al, Cr, AND Er IONS IN He AND N_2. Lockwood, G. J. (Sandia Labs., Albuquerque, NM). Phys. Rev., A; 7: No. 1, 125-129(Jan 1973).

Absolute measurements are reported of the total cross sections for charge transfer and stripping of Er^+, Er^{2+}, Al^+, and Cr^+ ions incident on He and N_2 in the energy range from 15 to 100 keV. These measurements include σ_{10}, σ_{12}, and σ_{21}. The σ_{12} cross sections are greater than those of the σ_{10} at the same velocity for all ions except Cr^+. Charge-transfer cross sections σ_{10} have a velocity dependence which is not predicted by the simple adiabatic criterion. (auth)

15785 CHARGE TRANSFER IN H^+–H^- COLLISIONS. Roy, K.; Mukherjee, S. C. (Indian Association for the Cultivation of Science, Calcutta). Phys. Rev., A; 7: No. 1, 130-134(Jan 1973).

The cross section for the charge transfer in $H^+ - H^-$ collisions is theoretically investigated. An expansion in terms of products of atomic wave functions was used which takes account of the possibilities of the capture of an electron into the 2s, $2p_0$, and $2p_{\pm 1}$ states. Theoretical results for the capture cross section were presented for the incident ion energy ranging from 0.5 to 8 keV. Variation with the impact parameter of the probabilities of capture into the excited states were also shown for several incident ion energies. The present theoretical results for the total capture cross sections are found to be in much better agreement with the experimental findings than are the previously calculated values of Bates and Lewis. (auth)

15786 POSITRON TRANSMISSION AND SCATTERING MEASUREMENTS USING SUPERPOSITION OF ANNIHILATION LINE SHAPES: BACKSCATTER COEFFICIENTS. MacKenzie, I. K.; Shulte, C. W.; Jackman, T.; Campbell, J. L. (Univ. of Guelph, Ont.). Phys. Rev., A; 7: No. 1, 135-145(Jan 1973).

Backscatter coefficients were measured for positron spectra emitted by radioactive sources and incident on 20 elements ranging from Li to U. The technique, based on recording the annihilation-γ-ray spectrum in a Ge (Li) detector, eliminates uncertainties encountered in methods where the positrons themselves are detected. The coefficient R for backscatter into 2π is found to vary with atomic number Z according to the relationship $R = 0.342 \ln Z - 0.146$. (auth)

15787 SCATTERING OF LIGHT IONS IN THE WEAKLY SCREENED COULOMB FIELD OF GOLD NUCLEI. Andersen, H. H.; Boettiger, J.; Knudsen, H. (Univ. of Aarhus, Denmark). Phys. Rev., A; 7: No. 1, 154-159(Jan 1973).

The differential cross section for scattering of 300 to 2000-keV H^+ and 300 to 500-keV He^+ and Li^+ through 3° to 15° by gold targets was measured. The targets were thin (34 to 220 μg/cm^2), vacuum-deposited polycrystalline foils. To eliminate the influence of multiple scattering, several target thicknesses were used to allow extrapolations to zero thickness. The agreement the experimental data, theoretical predictions, and published experimental data is found to be satisfactory. (auth)

15788 EQUILIBRIUM CHARGE-STATE DISTRIBUTIONS OF 2- TO 15-MeV TANTALUM AND URANIUM IONS STRIPPED IN GASES AND SOLIDS. Wittkower, A. B. (High Voltage Engineering Corp., Burlington, MA); Betz, H. D. Phys. Rev., A; 7: No. 1, 159-167(Jan 1973).

Equilibrium charge-state fractions were measured for tantalum and uranium ions with energies of 2, 4, 6, 8, 10, and 15 MeV, stripped in H_2, He, N_2, O_2, Ar, Kr, Xe, carbon, and gold. Average charge and form of the charge distributions and the dependence on ion velocity and target species are discussed. The results on the average charge are compared with theoretical and semiempirical predictions. An anomaly was found in the particular case of helium targets in which certain charge-state fractions are of unusual magnitude, leading to a relatively high average charge. (auth)

15789 EXTENDED ION–ELECTRON COINCIDENCE MEASUREMENTS OF THE VIOLENT $Ar^+ + Ar$ COLLISION. Thomson, G. M. (Georgia Inst. of Tech., Atlanta); Smith, W. W.; Russek, A. Phys. Rev., A; 7: No. 1, 168-174(Jan 1973).

The energy spectra of electrons ejected from 25-keV $Ar^+ + Ar$ collisions were measured. By employing the coincidence technique one was able to study specifically those electrons from collisions in which the projectiles were scattered through a known angle, $\theta = 21° \pm 2°$, and were ionized to a known final charge m. Data were taken in the range of ejected-electron energies from 10 to 250 eV. The data reveal both fast electrons produced by Auger transitions which fill vacancies in the inner (L) shell and slow electrons produced by excitation of the outer (M) shell. A detailed examination of the spectra supports the conclusion that slow electrons may be ejected after as well as before the Auger event. Furthermore, the ratio of the number of fast Auger electrons to the number of slow electrons observed indicates that most inner-shell vacancies are filled after the ions have separated to a considerable extent. (auth)

15790 PRODUCTION OF AN EXCITED ION BY COLLISION OF TWO METASTABLE ATOMS. Bochkova, O. P.; Tolmachev, Yu. A. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 4, 436-7 (Apr 1972).

Translated from Opt. Spektrosk.; 32: No. 4, 827-9(Apr 1972).

The collision process of two excited atoms that results in the ionization of one of the atoms and its simultaneous excitation is examined. This process can be detected spectroscopically from the emission of the ion spectrum. The investigations were performed in a He–Xe discharge. The results are described. (MOW)

15791 OPTICAL MEASUREMENT OF ELECTRON-IMPACT EXCITATION OF XENON AND MOLECULAR NITROGEN IN THE THRESHOLD REGION WITH HIGH ENERGY-RESOLUTION. Kisker, E. (Univ., Hamburg). Z. Phys.; 257: No. 1, 51-61 (1972). (In German).

Relative optical excitation functions of Xe and N_2 were measured in the threshold region. The inciting electron beam had a FWHM of 50 meV. The threshold behavior of the excitation functions of p levels of xenon is strongly influenced by resonances. The onset is step-like, in some cases resonance structure is to be seen just above threshold. In some excitation functions resonance structure is found immediately above the ionization limit. This is believed to be caused by two compound states the parent states of which could be the 6d′ and the 8s′ autoionizing state of xenon. In nitrogen, the excitation functions of two bands of the second positive group were measured (3371 and 3755 Å), the upper levels of which are the v = 0 and the v = 1 levels of the $C^3\Pi_\mu$ state. The excitation rises linear from threshold. In the 3371 Å excitation function a resonance maximum at 11.50 eV is observed, where the cross section is increased due to resonance population by about 100%, as measured with a FWHM of 50 meV of the electron beam. The broad absolute maximums of the excitation functions are found to lie at 14.0 ± 0.1 eV in the case of the 3371-Å and at 14.3 ± 0.1 eV in the 3755-Å band. (auth)

15792 EXCITATION OF CADMIUM ATOMS BY SLOW Cd^+ IONS. Zavilopoulo, A. N.; Shpenik, O. B.; Zapesochnyi, I. P. Opt. Spectrosc. (USSR) (Engl. Transl.); 32: No. 4, 341-2(Apr 1972).

Translated from Opt. Spektrosk.; 32: No. 4, 641-4(Apr 1972).

Results obtained for the first time are presented on the excitation of resonance and other most intensive spectral lines of cadmium atoms. The lines are produced by collisions of Cd atoms and Cd^+ ions in the energy range from the threshold to 1000 eV. The structure of the excitation functions was found for the majority of measured lines. For lines of one series, the slope of the curve in the energy region close to the threshold significantly increases with increasing principal quantum number, and the oscillating character of the excitation functions becomes stronger. (auth)

15793 QUADRATIC APPROXIMATION IN THEORY OF ELECTRON DETACHMENT DURING COLLISION OF A NEGATIVE ION WITH AN ATOM. Devdariani, A. Z.; Demkov, Yu. N. Vestn. Leningrad. Univ., No. 16, Fiz. Khim.; No. 3, 23-34(Aug 1971). (In Russian).

An accurate solution is derived for the nonstationary problem

of electron detachment from the bound state when the discrete level of time, depending on the energy operator, reaches the boundary of the continuous spectrum only at a single point in time. In this case, the approximation of zero-range potential with the quadratic time dependence of the boundary condition is used. The probability that the electron remains in the bound state after the interaction and the energy distribution of the detached electrons is found. For the same case an accurate solution of the scattering problem is obtained that made it possible to form the complete S matrix. The possibility of comparing the results obtained with those of experiments on the electron detachment in the collision of negative ions with neutral atoms is considered. (auth)

Atomic Theory

Refer also to abstracts 15750 and 15777.

15794 GEOMETRY OF SYMMETRIZED STATES. Gilmore, Robert (Massachusetts Inst. of Tech., Cambridge). Ann. Phys. (N. Y.); 74: No. 2, 391-463(Dec 1972).

A projection operator is defined in terms of coset representatives and "coset harmonics." This operator is then used to construct fully symmetrized states describing N identical two-level atoms. The properties and quantum numbers of the symmetrized states are fully discussed. Fully symmetrized and labeled states for N identical 3 (or r) level atoms are constructed by a natural extension of this procedure. The interaction Hamiltonian, which describes transitions in an r-level atom, is constructed from the shift operators in the algebra of SU(r). When each of the N identical atoms "sees" the same field dependence, transitions are only allowed between energy eigenstates occurring within the same SU(r) unitary irreducible representation. Physical dispersion of the particles out of the coherence region of the field leads to "leakage" out of an SU(r) representation. If each two-level atom evolves from the ground state under the same field dependence, the total system state is a coherent superposition of bases belonging to the fully symmetric representation $\{N = 2J\}_2$. These states exist in 1−1 correspondence with points in the surface of a unit sphere. They are therefore called Bloch states. The properties of Bloch states are derived and are seen to resemble the properties of coherent photon states. The connection is made manifest by a group contraction process. All properties of Glauber states can be constructed by contraction from the corresponding properties of the Bloch states. The states corresponding to N-identical r-level particles evolving under a coherent field are constructed in the same way. These states exist in 1−1 correspondence with points in the coset space SU(r)/U(r − 1), which is a Riemannian-symmetric space. The eigenstate expansions, inner products, eigenvalue equations, and uncertainty relations for these states are derived. More generally, systems of N identical (p + q) level atoms, evolving from the lowest q levels under a coherent field, are described by states existing in 1−1 correspondence with Riemannian symmetric space SU(p + q)/S[U(p)xU(q)]. The properties of these spaces are used to give a geometric analytic interpretation to these coherent atomic states. (auth)

15795 CALCULATION OF DISPERSION FORCES BY MOMENT THEORETICAL METHODS. Starkschall, G. Cambridge, MA; Harvard Univ. (1972). 100p. University Microfilms Order No. 72-24,654.

Thesis.

The calculation of dispersion forces is studied. By the application of some results from the theory of moments and the calculational technique of linear programming, hypothetical oscillator strength distributions are constructed which reproduce certain given information about the true oscillator strength distributions and which also provide upper and lower bounds to the true values of the dispersion interactions of interest. These techniques also enable uncertainties in the input information to be accounted for. Dipole−dipole dispersion forces are calculated for all rare gases, the H_2 molecule, and the H atom. In the last case, the contribution to the dispersion force from the H atom can be treated exactly. Dipole−quadrupole dispersion forces are calculated for He, and a direct comparison is made between the exact moment theory solution and the linear programming approximation. Three-body and relativistic dipole dispersion interactions are also calculated for all the aforementioned systems. The theory of moments is compared with the theory of sum rule functions and sum rule function theory is extended somewhat by means of moment theory. Finally a method is presented for estimating dispersion force coefficients of arbitrary order in the multipole interaction. (Diss. Abstr. Int., B)

15796 LAGRANGIAN OF THE THOMAS–FERMI MODEL. Knapecz, G. (Technical Univ., Budapest). Period. Polytech., Elec. Eng.; 16: No. 2, 173-6(1972).

The Thomas−Fermi model is a quasi-classic approximation of quantum mechanics which, in good approximation, describes the basic states of centrally symmetric atoms, molecules, and ions, and generally those systems that consist of a number of particles obeying Fermi−Dirac statistics (electrons, neutrons, protons, etc.). It is shown that the Thomas−Fermi equation of the statistical theory of atoms and molecules may be derived from a Lagrangian. The concrete form of this Lagrangian is established. Derivation is in the form of Eulerian equations, and it is proved that the Lagrangian is equivalent to the total energy density of the system. (JPRS)

15797 GENERALIZATION OF THE THEORY OF THE EXTENDED METHOD OF CALCULATION FOR COMPLEX CONFIGURATIONS OF ATOMIC ELECTRONS. Jucys, A. P.; Nashlenas, E. P.; Zhvirblis, P. S. (Vilnyus State Univ., USSR). Liet. Fiz. Rinkinys; 12: No. 2, 201-10(1972). (In Russian).

The theory of the extended method of calculation has been generalized for the atoms having complex configurations. The methods presented consist in giving the rules allowing the radial integrals of the ordinary method to be substituted by those of the extended method of calculation. These rules are given for the overlap integral of two different configurations as well as for the one- and two-electron operator matrix elements. (auth)

15798 PHASE-AMPLITUDE METHOD IN ATOMIC PHYSICS. II. Z DEPENDENCE OF SPIN-ORBIT COUPLING. Dehmer, J. L. (Univ. of Chicago). Phys. Rev., A; 7: No. 1, 4-9(Jan 1973).

The spin−orbit interaction for p electrons is shown to occur in the K shell for all atoms and to vary with atomic number Z according to $\Delta\mu \propto H\alpha^2(0,Z)/Z$, where $\Delta\mu$ is the difference in quantum defect between the fine-structure levels evaluated at the series limit, $\alpha(0,Z)$ is the amplitude function for a nonrelativistic zero-energy p wave at r = 0, and H is a relativistic correction factor. The quantity $\Delta\mu$ is evaluated and found to vary as $Z^{2.33}$, which is in remarkable agreement with experiment. In addition to this gross behavior, the variation of $\alpha^2(0,Z)/Z$ exhibits a structure tied to the Periodic Table. This structure derives from the influence of the valence region of the atomic potential, which affects the spin−orbit interaction through the normalization factor $\alpha(0,Z)$. Neither inner screening effects, embodied in Casimir's $\sigma(Z)$ parameter, nor deviations of the atomic potential from Zr^{-1} in the interaction region appear very relevant to this problem. (auth)

15799 ENERGY-OPTIMIZED SPIN ORBITALS IN ACCURATE ELECTRONIC CALCULATIONS. Bunge, C. F. (Univ., Sao Paulo, Brazil). Phys. Rev., A; 7: No. 1, 15-20(Jan 1973).

Eigenfunctions are considered for a well-defined operator related to $\int\Psi^*(1',2,\ldots,N) \times H(1,2,\ldots,N)\,\Psi(1,2,\ldots,N)\,d(2,3,\ldots,N)$, where Ψ is a configuration-interaction (CI) wave function which includes the Hartree−Fock configuration and all double excitations and H is the N-electron Hamiltonian of an atomic or molecular system. They satisfy for the energy the same optimum convergence properties as Loewdin's natural spin orbitals satisfy for the wave function. They are equal to the natural spin orbitals when Ψ is the exact wave function or a full CI wave function; Ψ may correspond to the ground state or to any excited state. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

15800 ION-CURRENT DISTRIBUTIONS AROUND AN ELECTRICALLY CONDUCTIVE BODY IN IONIZED GAS FLOW. Tsuji, Hiroshi (Tokyo Univ.); Hirano, Toshisuke. AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 11: No. 1, 100-102(Jan 1973).

The experiment was performed using a rectangular test duct and three kinds of cylinders and a flat plate. The homogeneous mixture of propane and air was fed from a multiple port burner. Ion-current distribution measurements were made for each configuration. (MOW)

15801 DEVELOPMENT OF MAGNETOHYDRODYNAMIC FLOW DUE TO THE PASSAGE OF AN ELECTRIC CURRENT PAST A SPHERE IMMERSED IN A FLUID. Sozou, C. (Univ. of Sheffield, Eng.). J. Fluid Mech.; 56: No. 3, 497-503(12 Dec 1972).

The development of magnetohydrodynamic flow due to the passage of a uniform electric current past a sphere immersed in an incompressible viscous conducting fluid extending to infinity is considered. The flow field is the response of the fluid to the Lorentz force set up by the electric current and the associated magnetic field. The solution is based on the assumption that the flow field is weak and has a negligible effect on the electromagnetic variables. It is also assumed that the convection terms in the momentum equation are negligible. The solution, obtained by means of Laplace transforms, is analytic except for the evaluation of an integral which is done numerically. It is shown that the flow field spreads radially from the sphere into the fluid. The rate of development of the flow field increases with the ratio of the conductivity of the sphere to that of the fluid. (auth)

15802 STEADY TRANSVERSE PLANE MAGNETOGASDYNAMIC FLOWS. Chandna, O. P. (Univ. of Windsor, Ont.). Can. J. Phys.; 50: No. 21, 2565-2567(1 Nov 1972).

A compatibility equation is obtained for steady plane transverse MHD flows and, as an example, solutions are obtained for radial flows. The geometric implication, when the compatibility equation does not hold, is also determined. (auth)

15803 DETONATION WAVES IN RELATIVISTIC MAGNETOHYDRODYNAMICS. Cissoko, M. (College de France, Paris). Ann. Inst. Henri Poincare, Sect. A; 17: No. 1, 43-57(1972). (In French).

The properties of magnetohydrodynamic detonation waves and their different velocities are investigated, certain hypotheses being made concerning the relativistic compressibility and the combustion. A theorem on the existence and unicity of a non-trivial solution of the detonation equation is deduced. (auth)

15804 MAGNETOHYDRODYNAMIC FLOW PAST A HOLLOW SPHERE. Levy, T. (Paris Univ.). Ann. Inst. Henri Poincare, Sect. A; 17: No. 1, 1-42(1972). (In French).

The steady flow of an incompressible, viscous, and electrically conducting fluid past a hollow sphere in a magnetic field is considered, the flow and the magnetic field at infinity being uniform and parallel. The Hartmann number, M, magnetic Reynolds number, R_m, and Reynolds number, R, are assumed to be small and of the same order of magnitude. The solution requires the matching of two asymptotic expansions for each quantity. (France)

PHYSICS (HIGH-ENERGY)

Refer also to abstract 15466.

Particle Interactions and Properties (Experimental)

Refer also to abstract 14899.

Electromagnetic

Refer also to abstracts 15844 and 16119.

15805 (JINR-D1-6349, pp 574-85) HADRON PHOTOPRODUCTION IN NUCLEI. Schuhl, C. (CEN de Saclay, Gif-sur-Yvette, France).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

New results on hadron production on nuclei from three different types of experiments are presented and analyzed. These include the study of $\rho\omega$ interference in dipion photoproduction from nuclei; the photoproduction at high energy as a tool for studying the nuclear matter; and preliminary results concerning $p\pi$ photoproduction on nuclei. (LBS)

15806 (KFK-EXT-3/72-1) MEASUREMENTS OF THE ELECTROPRODUCTION OF THE $\Delta(1236)$ RESONANCE ON THE PROTON AND THE NEUTRON. Bleckwenn, J. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jan 1972. 58p. (In German). INIS.

Cross sections for electroproduction on protons and neutrons were investigated by momentum analysis of scattered electrons. For momentum transfers $0.1 < (-q^2) < 0.5$ (GeV/c)^2 and invariant masses $W < 1.4$ GeV of the final hadronic state the measured cross section was split up into a resonant and a nonresonant contribution. The magnetic transition form factor of the $\gamma N\pi$-vertex was derived from the resonant cross section. The equality of resonant respective nonresonant part of the excitation cross section on protons and neutrons permits one to derive upper limits for isoscalar and isotensor currents to electroproduction processes. Total cross sections for absorption of real photons were derived from measured values by extrapolation to $q^2 = 0$. Furthermore, semilocal duality was tested for protons in the region of q^2 mentioned above. (auth)

15807 INVESTIGATION OF SINGLE PRODUCTION OF π^+-MESONS ON A COMPLEX TARGET. Avdeev, V. A.; Belyalov, R. A.; Epaneshnikov, V. D.; (and others) (Tomsk Polytechnic Inst., USSR). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 333-335 (1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 32-33(1972).

A procedure is expounded which is used to measure the asymmetry of π^+-meson production by linearly polarized photons in the region of the first resonance on a complex polyethylene target. The difference method and recording of the coincidence of a π^+ meson and a recoil neutron were used, which allowed an accuracy to be obtained that was on the same level as the accuracy obtained by performing measurements with a liquid-hydrogen target. (2 figures) (auth)

Weak

Refer also to abstracts 14908 and 14909.

15808 (JINR-D1-6349, pp 531-9) GARGAMELLE EXPERIMENTS WITH NEUTRINOS. Rousset, A. (CERN, Geneva).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

A brief description is given of the CERN Gargamelle heavy-liquid bubble chamber and of an experiment in progress to study deep-inelastic neutrino interactions in pure freon. Preliminary results are given of a search for new sources of neutrinos. (LBS)

15809 (JINR-E2-6601) SUMMARY OF THE FIRST PART OF THE NEUTRINO-72 EUROPHYSICS CONFERENCE, BALATONFUERED. Pontecorvo, B. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 26p. (CONF-720651-2(Summ.)). Dep. NTIS (U. S. Sales Only).

From Symposium on neutrino-72; Balatonfuered, Hungary (11 Jun 1972).

This review covers the following problems: the $K_2^0 \to 2\mu$ puzzle, solar neutrinos, lepton charge conservation, "stable" heavy leptons, ν_e -e scattering (reactor + electronics), and neutral currents (accelerators + bubble chambers). (auth)

15810 (JINR-P6-6822) DEPENDENCE OF THE ASYMMETRY OF NEGATIVE MUON DECAY ELECTRONS ON THE LENGTH OF THE HYDROCARBON CHAIN OF ALCOHOLS AND ALKYL CHLORIDES. Dzhuraev, A. A.; Evseev, V. S.; Obukhov, Yu. V.; Roganov, V. S.; Frontas'eva, M. V.; Kholodov, N. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

Relative (relative to graphite) values of the asymmetry coefficients a/a_c in the angular electron distribution from stopped muon $\mu^- \to e^-$-decay in aliphatic alcohols $C_nH_{2n+1}OH$ and in chlorine-substituted paraffins $C_nH_{2n+1}Cl$ with different number of carbon atoms in the chain are obtained in the weak transverse magnetic field by the muon spin precision method. With the increasing n_c the values a/a_c pass the maximum and tend to the limit determined by asymmetry coefficient values for paraffin and polyethylene. The obtained dependence is interpreted based on the representations for chemical interactions of mesic atoms, leading to the production of diamagnetic compounds, and the representations for energy migration in the carbon atom chain. (auth)

Strong (Baryon-induced)

Refer also to abstract 16045.

15811 (ITF-72-152-E) pd-, dd-SCATTERING AND POMERON TRAJECTORY. Il'in, V. V.; Enkovskii, L. L.; Tutik, R. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 7p. Dep. NTIS (U. S. Sales Only).

The possibility of the determination of the form of the vacuum trajectory from experimental data on pd- and dd-scattering is studied. (auth)

15812 (JINR-P1-6714) REACTIONS WITH DEUTERON BREAK-UP IN dp-INTERACTIONS AT 3.3 GeV/c IN HYDROGEN CHAMBER. Glagolev, V. V.; Zelinski, P.; Lebedev, R. M.; Hassal'aki, Ya.; Nioradze, M. S.; Saitov, I. S.; Sandach, A.; Strel'tsov, V. N.; Stepanyak, I.; Sharkhu, G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

Experimental data are presented on dp-interactions with the deuteron decay in hydrogen bubble chamber. The advantages are shown which appear when irradiation of this chamber is performed by deuterons as compared with the irradiation of a deuterium chamber with protons. Data on elastic np-scattering are obtained, in particular, the cross section value for np-charge exchange. (auth)

15813 (LBL-749) INCLUSIVE REACTIONS $pp \to \pi^+ +$ ANYTHING AND $pp \to p +$ ANYTHING AT 6.6 GeV/c COMPARED TO HIGHER ENERGIES. Gellert, E. R. (California Univ., Berkeley. Lawrence Berkeley Lab.). 27 Oct 1972. Contract W-7405-eng-48. 23p. Dep. NTIS.

Thesis.

The π^-, π^+, and proton inclusive distributions resulting from the exposure of a liquid-hydrogen bubble chamber to a 6.6- GeV/c proton beam are studied and compared to higher energies. In the target region (Feynman's $x < -0.4$) the π^- laboratory differential cross section is found to be energy dependent, provided that $p_\perp < 0.6$ GeV/c. However, the structure function $\rho(x,p_\perp,s) = Ed^3\sigma/dp^3$ is found not to be energy independent in the central region ($p_\parallel \approx 0$), but the nonscaling term is consistent with $s^{-\frac{1}{2}}$ dependence. The π^+-spectra behave quite differently. In the target region the π^+ laboratory differential cross section is found to exceed that at higher energies, whereas in the central region ρ is found to be energy independent for small transverse momentum, at least in incident momentum interval 6.6 to 28.5 GeV/c. For protons ρ is found to decline with energy in the interval 6.6 to 24 GeV/c (and possibly to ISR energies and above) in both the target and central region, with the greatest decline occurring in the central region. Graphs of various single and double differential cross sections are presented. (auth)

15814 (UCR-34-P-107-B-138) SPIN PARITY DETERMINATION OF DIFFRACTIVELY PRODUCED N*. Oh, Y. T.; Fung, S. Y.; Kernan, A.; Poe, R. T.; Schalk, T. L.; Shen, B. C. (California Univ., Riverside. Dept. of Physics). 1972. 15p. Dep. NTIS.

A study of the decay $N^{*0} \rightarrow \pi^- p$ for N*(1500) and N*(1690), produced by diffraction dissociation, leads to a spin-parity assignment of $3/2^-$ and $5/2^+$ for these two states. The production process $\pi^- n \rightarrow \pi^- N^{*0}$ conserves t-channel helicity. (auth)

15815 MULTIPARTICLE ANNIHILATIONS OF ANTIPROTONS IN HYDROGEN. Danysz, J. A. (Inst. of Nuclear Research, Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 79-85(1969).

A review is given on $\bar{p} + p$ interactions at 0 to 7 GeV/c. Meson resonance production, cross sections, and one-particle angular distributions found experimentally are discussed. Also various particle models are briefly reviewed. (JFP)

15816 HEAVY NUCLEON RESONANCES IN HIGH MULTIPLICITY INELASTIC COLLISIONS. Czyzewski, O. (Inst. of Nuclear Research, Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 107-113(1969).

A review is given of the formation of heavy nucleon isobars in high multiplicity processes in $\pi + p$ interactions. (JFP)

15817 HADRON INTERACTION WITH NUCLEI AT HIGH ENERGIES. Azimov, S. A.; Abdullaev, A. M.; Gabrilin, E. V.; (and others) (Physical-Technical Inst., Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 6, 22-24(1972). (In Russian).

The inelastic interaction of cosmic ray hadrons with nuclei was studied in the energy range $E_0 = 200$ to 2,000 GeV. The targets used were paraffin, Al, and Fe. The angular distribution of shower particles formed by hadron collisions with the paraffin nuclei was investigated as a function of E_0. (KSW)

Strong (Meson-induced)

Refer also to abstracts 14880, 14881, 15896, 16038, and 16224.

15818 (FRNC-TH-223) CONSERVATION OF HELICITY IN THE $\pi N \rightarrow N3\pi$ and $\pi d \rightarrow d3\pi$ DIFFRACTIVE REACTIONS. Thermes, C. (Paris Univ., Orsay (France)). 1971. 48p. (In French). NTIS (U. S. Sales Only).

Thesis.

The disintegration of A_1 was analyzed and the diffractive events were studied in a manner independent of the spin in the framework of a π-deuterium experiment in which coherent reactions were observed. The neutron interaction channel was also studied and in this way $\pi + d \rightarrow A_1 d$ and $\pi + n \rightarrow A_1 n$ reactions were compared. The helicity state of a A_1 produced in these reactions was studied by investigating the angular distributions of the A_1 disintegration products and determining the elements of the density matrix. It was postulated that a state of pure spin parity 1^+ is followed by a mixed $(1^+,0^+)$ state. The diffractive events were examined using the Cohen–Tanoudji test. (auth)

15819 (IFVE-SEF-71-95) MEASUREMENTS OF THE CROSS SECTION FOR THE REACTION $\pi^- p \rightarrow \pi^0 n$ IN THE MOMENTUM RANGE UP TO 50 GeV/c. Bolotov, V. N.; Vasil'ev, L. M.; Grachev, M. I.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 9p. (In Russian). INIS.

Cross sections for pion charge exchange reactions on protons from 20 to 50 GeV/c are presented. (auth)

15820 (JINR-D1-6349, pp 39-54) PRODUCTION OF PARTICLES AND RESONANCES ON NUCLEI. Beusch, W. (CERN, Geneva).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The optical model for coherent production of particles on nuclei is used to fit experimental data on 3π and 5π production by incident pions. Fits are also made to experimental data on $K\pi\pi$ and $K^*(890)$ production on nuclei by incident kaons. Mass distributions and t' distributions are presented. (LBS)

15821 (JINR-D1-6349, pp 57-67) SEARCH FOR RESONANCES WITH BARYON NUMBER B = 2, 3, AND STRANGENESS S = 0, −1, −2. Shakhbazyan, B. A.; Timonina, A. A. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Resonances with baryon number B > 1 and strangeness S = 0, −1, and −2 were investigated by studying the spectra of effective masses of the systems (pp), (Λp), (ΛΛ), and (Λpp) as formed in the interaction of neutrons with $\langle p \rangle = 7.5$ GeV/c and π^--mesons at 4.0 GeV/c in carbon nuclei. The experiments were carried out in the 55 cm propane bubble chamber. Four systems are specifically discussed. The first system was (Λp) with B = 2; S = −1, and 204 events from 1,548 interactions were processed. The second system was (pp) with B = 2; S = 0 (230 proton-similar events). The third system was (ΛΛ) with B = 2; S = −2 (50 events). The fourth system was (Λpp) with B = 3; S = −1 (742 events). (KSW)

15822 (JINR-D1-6349, pp 68-76) PRELIMINARY RESULTS FROM A STUDY ON S = −2 DIBARYON FINAL STATES IN A HEAVY LIQUID BUBBLE CHAMBER.

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Some preliminary results are reported of a search for events with two Λ°'s in the final state from a 650,000 picture exposure of the RHEL-UCL heavy liquid-bubble chamber to a 2.1 GeV/c K^- beam. 376 events were found in a scan for S = −2 final states whose primary aim was to obtain a sample of the decays of Ξ^- hyperons produced in reactions $K^- N \rightarrow \Xi K\,(m\pi)$, $m \geq 0$. The ΛΛ invariant mass spectrum is studied and discussed. (LBS)

15823 (JINR-D1-6349, pp 431-45) CAPTURE OF π^- MESONS BY BOUND HYDROGEN AND SEVERAL PROBLEMS OF THE STRUCTURE OF MATTER. Petrukhin, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The probability of the formation of π^0-mesons during the capture of π^--mesons by a nucleus was studied with targets of liquid hydrogen. The probability of the reaction $\pi^- + p \rightarrow \pi^0 + n$, $\pi^0 \rightarrow \gamma + \gamma$ in liquid hydrogen is about 60%. In subsequent experiments, C_2H_6, D_2, He, Ne, and Ar were used in targets. Capture of π^--mesons in compounds containing hydrogen was investigated: KOH, $Al(OH)_3$, H_2SO_4, $H_2C_2O_4$, $NaHCO_3$, H_3BO_3, hydrocarbons, and a number of hydrated metal salts. (KSW)

15824 (SLAC-Trans-150) ELASTIC π^-p, K^-p, AND $\bar{p}p$ SCATTERING AT 25 AND 40 GeV/c. Antipov, Yu. M.; Busnello, R.; Weitsch, A.; (and others) (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). Translated from report IFVE-SEF-72-26. 12p. Dep. NTIS.

The results of measurements of elastic π^-p, K^-p, and $\bar{p}p$ scattering in the momentum-transfer interval $0.10 < |t| < 0.40$ $(GeV/c)^2$ at primary beam momenta of 25 to 40 GeV/c are reported. The slopes of the cones of elastic π^-p and K^-p scattering do not change in the primary momentum interval of 2 to 40 GeV/c, but in the case of $\bar{p}p$ scattering the possibility of a small reduction in the slope parameter cannot be excluded. (auth)

15825 (UCR-34-P-107-B-128) RESONANCE PRODUCTION IN π^-d AT 11.6 GeV/c. Oh, Y.; Fung, S. Y.; Kernan, A.; Poe, R. T.; Schalk, T. L.; Shen, B. C. (California Univ., Riverside. Dept. of Physics). 1971. 12p. (CONF-710609-17). Dep. NTIS.

From International conference on elementary particles; Amsterdam, Netherlands (30 Jun 1971).

The reactions $\pi^- + d \rightarrow 2\pi^- + 2p$ and $\pi^- + d \rightarrow 2\pi^- + \pi^+ + d$ interactions at 11.6 GeV/c in a bubble chamber were studied. The effective mass, momentum, and angular distributions and the decay angular distribution of N* for the $\pi^- + n \rightarrow 2\pi^- + p$ interaction were discussed. Also the 3π effective mass distribution of the $\pi^- + d \rightarrow 2\pi^- + \pi^+ + d$ interaction was considered with $A_1(1080)$ production, mass, and width. (JFP)

15826 (UCR-34-P-107-B-136) AMPLITUDES FOR $\pi^+ + p \rightarrow \pi^0 + \Delta^{++}$, $\rho^+ + p$ AT 1.3 TO 1.8 GeV/c. Kernan, Anne (California Univ., Riverside. Dept. of Physics). 1972. Contract AT(04-3)-34. 30p. (CONF-720444-2). Dep. NTIS.

From Meeting of the American Physical Society; Washington, D. C. (24 Apr 1972).

Differential cross sections and density matrix elements for the reactions $\pi^+p \rightarrow \pi^0\Delta^{2+}(1236)$ and $\pi^+p \rightarrow \rho^+p$ were measured at seven momenta between 1.28 and 1.84 GeV/c. The data come from a high statistics bubble chamber exposure which gave 41,000 events in the channel $\pi^+p \rightarrow \pi^+\pi^0p$. Results are given on: coupling of isospin 3/2 nucleon resonances in the mass internal 1820 to 2090 MeV to $\pi\Delta$ and ρN channels, duality between peripheral resonances and the ρ Regge pole in $\pi^+p \rightarrow \pi^0\Delta^{2+}$, and dominance of π and ω exchange amplitudes down to threshold in $\pi^+p \rightarrow \rho^+p$, and possible dip mechanisms in this channel. (auth)

15827 $\pi^\pm - \alpha$ ELASTIC SCATTERING IN THE Δ RESONANCE REGION. Falomkin, I. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Kulyukin, M. M.; Lyashenko, V. (and others). Lett. Nuovo Cim.; 5: No. 18, 1125-8(30 Dec 1972).

A phase-shift analysis for π^+ and π^- elastic scattering was performed for the energy interval from 24 to 153 MeV. Results for the real part of the phase shift and inelasticity parameters are

shown. Argand diagrams for the s-wave, p-wave, and D-wave are also presented. It is noted that the resonance aspects in π-^{4}He scattering appear at a lower kinetic energy than the Δ_{33} resonance in πN scattering. (LBS)

15828 PRESENT STATUS OF THE EXPERIMENTAL ANALYSIS OF THE ORIGIN OF RESONANCES A_1, K**(1320), AND B(1220). Eskreys, A. (Inst. for Nuclear Research, Krakow). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 117-127 (1968).

The experimental status of the Deck effect and the A_1, K(1320), and B(1220) resonances in the three-body final states of π and K interactions with protons at 3.0 to 20.0 GeV/c is discussed. (JFP)

15829 THREE-BODY FINAL STATES IN KP INTERACTIONS. Eskreys, A. (Inst. for Nuclear Research, Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 125-134(1969).

The $K^+ + p$ and $K^- + p$ interactions at 2.0 to 10.0 GeV are reviewed. The review covers experimental cross sections, angular and momentum distributions, and resonance production. (JFP)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstracts 15976, 15978, and 16485.

15830 (CERN-72-20) OPTICAL CONCEPTS IN HIGH-ENERGY PHYSICS. Gottfried, K. (European Organization for Nuclear Research, Geneva (Switzerland)). 17 Nov 1972. 30p. Dep. NTIS (U. S. Sales Only).

The lectures cover the eikonal approximation for scatterings by potential at high energy, elastic scattering by deuterium, the optical model for elastic scattering, and coherent photoprocesses in nuclei. (JFP)

15831 (ITF-72-114-E) SCATTERING AMPLITUDE OF FOUR PARTICLES WITH EQUAL MASSES, WITHOUT SPINS: DUALITY, PARTIAL-WAVES AND REGGE RELATIONS, RESULTING FROM EXPANSIONS IN REPRESENTATION FUNCTIONS OF THE GROUP 0(3,C). Kirschbaum, D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 29p. Dep. NTIS (U. S. Sales Only).

A scattering process of four particles without spins with equal masses is considered. The scattering operator is given by one complex-valued function of Mandelstam variables. This function is considered in definite reference frames of momentum space and the well known parametrization of momentum vectors is corrected with angular variables of the group 0(3,C). Then expanding the scattering operator in terms of representation functions of the group 0(3,C), the resulting properties are considered for partial-wave series in the c.m.f., for every channel the right threshold behavior and cut structure of partial-waves is obtained. The b.w.f. analysis shows in each channel Regge behavior; the duality principle holds, because both analyses result from the same expansion (of scattering operator in representation functions of the group 0(3,C) as boundary cases. The mentioned properties result from the structure of representation functions of the group 0(3,C) and are in this sense kinematical results of this expansion of scattering operator. (auth)

15832 (RLO-2041-82) ANNUAL REPORT, 1972. Moravcsik, M. J. (Oregon Univ., Eugene. Inst. of Theoretical Science). 31 Oct 1972. Contract AT(45-1)-2230. 7p. Dep. NTIS.

Research on theoretical high energy physics is summarized. A list of publications is included. (JFP)

15833 (TIC-26244) FINAL REPORT, MARCH 1967-FEBRUARY 1972. (Pittsburgh Univ., Pa.). 1972. Contract AT(30-1)-3829. 11p. Dep. NTIS.

Theoretical research is summarized in high energy physics, quantum electrodynamics and quantum field theory. A list of publications is included. (JFP)

15834 (WIS-71/51-Ph) KINETIC EFFECTS IN EXCLUSIVE AND INCLUSIVE REACTIONS. Kluger, M.; Roberts, R. G. (Weizmann Inst. of Science, Rehovoth (Israel)). [nd]. 15p. INIS.

The behavior of one and two particle distributions from imposing only the requirements of phase space and a cut-off in the transverse momentum is studied. The study covers both exclusive and inclusive reactions. By estimating this cylindrical phase space and by carrying out Monte Carlo integrations features are observed which, at first sight, might be attributed to complicated dynamical effects. In particular strong correlation effects between pairs of final state particles are discussed. (auth)

15835 TOWARDS A UNIVERSAL MASS FORMULA FOR ELEMENTARY PARTICLES. Sivaram, C.; Sinha, K. P. (Indian Inst. of Science, Bangalore). Curr. Sci. (India); 42: No. 1, 4-6(5 Jan 1973).

A formula for calculating the masses of various elementary particles is developed on the basis of a dynamical theory. The calculated masses are in good agreement with the observed values. (auth)

15836 PROPERTY OF THE DIRAC EQUATION FOR A FREE PARTICLE WITH SPIN $\hbar/2$. Levin, E. S. (Leningrad Pedagogical Inst.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 33-6(1972). (In Russian).

The possibility was investigated of transforming the Dirac equation for a free particle with spin $\hbar/2$ to a form in which the circular fluctuation movement (Schroedinger's Zitterbewegung) was absent. Equations were obtained for determining the unitary transformation, and eliminating the "Zitterbewegung" in the Dirac theory. It was shown that only partial removal of "Zitterbewegung" was possible along one coordinate axis; complete elimination was impossible. An entire class of unitary transformations was examined which partially eliminated "Zitterbewegung," and their relation to well known canonic transformation was established. (tr-auth)

15837 APPROXIMATELY RELATIVISTIC LAGRANGIANS FOR CLASSICAL INTERACTING POINT PARTICLES. Woodcock, H. W. (Temple Univ., Philadelphia). Phys. Rev., D; 6: No. 12, 3422-3444(15 Dec 1972).

In classical special-relativistic dynamics, equations of motion for interacting point particles can be derived from Lorentz-invariant variational principles of the Fokker type. Similarly, approximately relativistic equations of motion for such particles, obtained by expansion of the exact equations in inverse powers of the speed of light, follow from variational principles involving approximately relativistic Lagrangians of the type first found by Darwin for electrodynamics. Here the general form of such Lagrangians is established by directly approximating Lorentz-invariant variational principles describing point particles interacting through two-body forces. Only interactions which possess a static Newtonian limit are considered; the interaction is not assumed to be symmetric in the particles' variables. The exact variational principle is assumed to depend at most on velocities and thus leads to at most acceleration-dependent forces. The same is found to be true of the approximate variational principles. The general approximate Lagrangian obtained is characterized by the absence of terms of order c^{-1} and by the possible presence, for each relativistic particle interaction, of three new functions of the Euclidean interparticle separation which may be independent of the static Newtonian potential. The form of the usual ten approximate conservation theorems is established using the invariance properties of the approximate Lagrangian. Two examples of approximate Lagrangians are evaluated explicitly. The first establishes the form of the approximate Lagrangians associated with relativistic particle interactions which allow definition of "adjunct fields," while the second establishes this form for a particular interaction connecting pairs of points on the world lines of particles with spacelike separation. Possible applications of the results in the classical and quantum domains are discussed. (auth)

15838 FRAGMENTATION IN A ϕ^3-THEORY LADDER MODEL. Rajaraman, R.; Banerjee, A. (Delhi Univ.). Phys. Rev., D; 6: No. 12, 3641-3650(15 Dec 1972).

The inclusive reaction $a + b \to c +$ (anything) is studied, where all the particles belong to a single scalar field $\phi(x)$ interacting through a $g\phi^3(x)$ term. This is done in a ladder model for the forward $ab\bar{c} \to ab\bar{c}$ process, whose amplitude is intimately related to the inclusive distribution. The choice of the infinite sequence of ladder diagrams as well as the assumptions involved are natural extensions of analogous work in the literature for four-point functions. In the fragmentation limit, the model yields the expected Regge behavior as the initial energy tends to infinity. An expression is derived for the limiting distribution function $E_c\,d\sigma/d\vec{p}_c$ for fixed $\vec{p}_c$ as $s \to \infty$. The results are derived both in the "leading-term approximation" as well as by an exact Mellin-transform method. (auth)

15839 PRINCIPLE OF HUYGENS FOR PARTICLES WITH ARBITRARY SPIN. Aliev, M.; Gulyamov, U. G. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 12, 24-6 (1971). (In Russian).

Following the suit of previous workers who used Huygen's formula for diffraction problems, scalar waves, and spinors, the present author employed it in the formalism of Duffin–Kemmer to study particles with random spin. (KSW)

15840 UNIFIED MODEL OF ELEMENTARY PARTICLES BASED ON LEPTONS. Fusaoka, H.; Katayama, Y. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1753-1754(Nov 1972).

A unified model of elementary particles is proposed based on the following: (i) Hadrons are composed of leptons and B-matters. (ii) All weak interactions originate from those of leptons. (iii) Strong interactions arise from B-matters. An outline of the model is given. (LBS)

15841 INTRODUCTION TO CURRENT ALGEBRAS. Suranyi, P. (Central Research Inst. for Physics, Budapest). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 101-110(1968).

A general description of the methods and applications of current algebra is given. While all the applications are not reviewed, the simple character of the calculations is emphasized. (JFP)

15842 DUAL CURRENTS WITH A CUT-OFF. Kobushkin, A. P. (Institut fuer Hochenergiephysik, Berlin). Lett. Nuovo Cim.; 6: No. 3, 89-93(20 Jan 1973).

The fishing-net diagram technique is used to construct dual amplitudes for currents. The basic idea is that the current interacts inside the Koba–Nielson disk (an on-mass-shell hadron interacts on the boundary of the Koba–Nielson disk), and that the invariance under Moebius transformations plays the major role. An amplitude was constructed which simultaneously has no exponential factor both in the form factor for large momentum transferred and in the forward Compton scattering amplitude in the Bjorken limit. The new cut-off does not violate the scaling behavior of the νW_2 function. (JFP)

Electromagnetic

Refer also to abstracts 15932, 15949, 15965, 15967, and 15979.

15843 (DESY–72/60) SPIN 3/2 CALCULATIONS: $\pi\Delta$ PHOTOPRODUCTION. Read, B. J. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sep 1972. 17p. Dep. NTIS (U. S. Sales Only).

The essential role of off-mass-shell terms in the propagator and interaction vertices for spin 3/2 particles is discussed, paying attention to the constraints of gauge invariance and point transformation invariance of the amplitude. The case of $\pi\Delta$ photoproduction is treated in detail; together with comments on low energy pion-nucleon scattering calculations. (auth)

15844 (DESY–72/61) RECENT DEVELOPMENTS IN ELECTRO- AND PHOTOPRODUCTION. Wolf, Guenter (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1972. 61p. Dep. NTIS (U. S. Sales Only).

This lecture covers three areas of photo- and electroproduction, for which new results have been obtained since the 1971 Cornell conference. These are the ρ', rho electroproduction, and the Q^2 dependence of the multiplicities and inclusive particle spectra. (auth)

15845 (ITF–72–123–P) ELECTROMAGNETIC INTERACTION OF THE NEUTRINO. Rekalo, A. P. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 31p. (In Russian). Dep. NTIS (U. S. Sales Only).

Different consequences which follow from the assumption that a hypothetical local $(\gamma\gamma)(\bar{\nu}\nu)$-interaction exists are considered. The restrictions on the value of the $(\gamma\gamma)(\bar{\nu}\nu)$-interaction constants are obtained. The cross sections for different processes due to $(\gamma\gamma)(\bar{\nu}\nu)$-interaction are calculated and the possibility of detecting such an interaction in the experiment with colliding ll^+-beams is discussed. The cross sections for the processes considered rapidly increase with energy. The amplitude of the process $\gamma + \gamma \to \nu + \bar{\nu}$ occurring throughout the intermediate $l\bar{l}$-state are also investigated (in the scheme of the weak $(\bar{l}l)(\bar{\nu}\nu)$-coupling of a general kind. In the limit of a small invariant mass of two photons this mechanism for $\gamma + \gamma \to \nu + \bar{\nu}$ process is equivalent to the local interactions introduced. (auth)

15846 RADIATIVE DECAYS OF BOSONS. van der Merwe, P. du T. (Atomic Energy Board, Pretoria). Z. Naturforsch.; 27a: No. 12, 1705-8(Dec 1972).

A simplified model of the radiative decays of pseudoscalar and vector mesons is investigated in the framework of a three-particle formalism for unstable composite particles in order to illustrate the role that unstable particles may play in providing information on the question of constituents of bosons. (auth)

15847 LOCALITY IN ELECTROPRODUCTION. Brandt, R. A.; Ng, W. C. (New York Univ., NY). Lett. Nuovo Cim.; 5: No. 18, 1137-42(30 Dec 1972).

A new sum rule is derived for electroproduction structure functions, which can be used to check whether the present data are consistent with the basic field theoretical notion of locality. It is found that the consistency condition is in striking agreement with the data. The sum rules can also be used to correlate low-energy and high-energy data and to obtain improved determinations of resonance and Regge parameters. The further implications of locality for threshold behavior and for resonance models are also discussed. (LBS)

15848 POLARIZATION PHENOMENA DURING PHOTOPRODUCTION OF FERMION PAIRS AND γ QUANTA ON NUCLEI. Nadzhafov, I. M. (Moscow State Univ.). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 106-10(1972). (In Russian).

The cross section of the process $\gamma + (Ze) \to (Ze)' + \gamma_1 + e^- + e^+$ was evaluated according to the angle of flight of the electron and positron, and the angular, energy, and spin dependencies of the cross section were obtained. The cross section of photoproduction of lepton-antilepton pairs and γ quanta by nuclei may predominate over Bethe–Heitler cross section for the ordinary photoproduction of e^-e^+ pairs in the case where the emitted photon moves in the same direction as the incident γ quanta. The probability of some spin states of an electron and positron was analyzed. (tr-auth)

15849 LONG-RANGE-POTENTIAL MODEL OF HADRONS. Suura, H. (DESY, Hamburg). Phys. Rev., D; 6: No. 12, 3538-3542(15 Dec 1972).

A hadron model is proposed in which nonasymptotic quarks interact with a coherent and long-range vector-gluon field, with a resulting linearly rising spectrum. Solutions for L = 0 pseudoscalar and vector mesons in this model exhibit an SU_6-type structure. The pion decay constant and the $\rho-\gamma$ coupling constant for the unperturbed ground states satisfy the Kawarabayashi-Suzuki-Riazuddin-Fayyazuddin relation and have the right order of magnitude. The ratio $\sigma(e^+ + e^- \to \text{vector mesons})/\sigma(e^+ + e^- \to \mu^+ + \mu^-)$ decreases like $s^{-\frac{1}{2}}$ in the present model, whereas it is shown that the ratio approaches a constant in the three-dimensional oscillator-potential model. (auth)

15850 SECOND-ORDER RADIATIVE CORRECTIONS TO THE TRIANGLE ANOMALY. II. Milton, K. A.; Tsai, W. Y.; DeRaad, L. L. Jr. (Univ. of California, Los Angeles). Phys. Rev., D; 6: No. 12, 3491-3500(15 Dec 1972).

In a preceding paper, the radiative correction to the "triangle anomaly," using source-theoretical techniques was calculated. Here the same methods are applied to a different causal arrangement, and the same result is obtained, giving a total anomaly through order α proportional to $1 + \alpha/2\pi$. In order to obtain this result, it was found necessary to compute (for $m_\pi = 0$) the first radiative corrections to the π^0 photoproduction amplitudes, which are presented here for the first time. (auth)

15851 MONOPOLE THEORY WITH POTENTIALS. Vinciarelli, Patrizio (Univ. of Maryland, College Park). Phys. Rev., D; 6: No. 12, 3419-3421(15 Dec 1972).

The Cabibbo–Ferrari two-potentials formalism is used to construct a representation of the gauge-independent electrically and magnetically charged Mandelstam field. This representation is applied to convert the Cabibbo-Ferrari-Coleman formulation of monopole theory into a more conventional one in terms of gauge-dependent fields and potentials. (auth)

15852 SU(4) LIGHT-CONE ANALYSIS OF DEEP-INELASTIC LEPTON SCATTERING. Budny, R.; Scharbach, P. N. (Oxford Univ.). Phys. Rev., D; 6: No. 12, 3651-3657(15 Dec 1972).

Linear relations and sum rules for deep-inelastic lepton scattering are derived from a set of weak, neutral, and electromagnetic currents based on several four-quark schemes. (auth)

15853 CONNECTION BETWEEN ELECTROPRODUCTION AND ANNIHILATION. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Phys. Rev., D; 6: No. 12, 3708-3711 (15 Dec 1972).

It is shown why the ladder-graph model is special in allowing analytic continuation of the deep-inelastic electroproduction structure functions to describe e^+e^- annihilation. It is also explained why this property cannot be expected to hold for more complicated graphs that also contribute in the Bjorken limit. (auth)

15854 QUARK–HADRON AMPLITUDES AND REGGE BEHAVIOR OF STRUCTURE FUNCTIONS IN THE ASYMPTOTIC SCAL-

ING REGION. Orzalesi, C. A. (New York Univ., NY). Phys. Rev., D; 6: No. 12, 3702-3704(15 Dec 1972).

For semileptonic deep-inelastic scattering in the asymptotic region (energy ≫ |lepton momentum transfer|), it is shown that the theoretically proposed and experimentally indicated Regge-like behavior of the scaling functions corresponds to the Regge behavior of quark-hadron amplitudes. This connection also gives the conditions for the occurrence of light-cone fixed poles in the ordinary Regge limit. (auth)

15855 LIGHT-CONE BEHAVIOR OF PERTURBATION THEORY. Christ, N. (Columbia Univ., New York); Hasslacher, B.; Mueller, A. H. Phys. Rev., D; 6: No. 12, 3543-3562(15 Dec 1972).

A technique introduced by Symanzik is used to derive a series of equations obeyed order by order in perturbation theory by the structure functions W_1 and νW_2 entering the cross section for inelastic electron scattering. These equations relate the q^2, ν, and coupling-constant dependence of W_1 and νW_2 in a manner reminiscent of the renormalization-group results of Gell-Mann and Low. The equations are used to compute the leading logarithmic contribution to νW_2 in a theory of fermions coupled to pseudoscalar particles and a theory of fermions coupled to vector particles. (auth)

15856 INELASTIC e^+e^- ANNIHILATION IN PERTURBATION THEORY. Fishbane, P. M. (Univ. of Virginia, Charlottesville); Sullivan, J. D. Phys. Rev., D; 6: No. 12, 3568-3587(15 Dec 1972).

The structure functions for the annihilation process $e^+ + e^- \rightarrow \bar{p} + X$ are calculated in the neutral-vector-gluon model in the Bjorken limit. Bjorken scaling is broken by the presence of $\ln q^2$ factors in a way which is closely related to the situation in inelastic scattering. All calculations are carried out in a leading-logarithm approximation. In particular there is a multiplicity $n \sim \ln^2 q^2$ and a close interplay between the damping of the elastic form factor and the excitation of inelastic channels. The annihilation structure functions are shown to be related to their inelastic scattering counterparts by analytic continuation and by a physical-region reciprocal relation. The reciprocal relation is observed to have a number of interesting consequences if it applies, in some approximate sense, to pions, protons, etc. In addition to the leading-logarithm calculations the discussions given here of discontinuities of the virtual Compton amplitude and the longitudinal-impact-parameter representation are of general interest and applicability. (auth)

15857 SUM RULES FOR REAL PARTS OF CURRENT–PARTICLE SCATTERING AMPLITUDES. Heimann, R. L.; Hey, A. J. G.; Mandula, J. E. (California Inst. of Tech., Pasadena). Phys. Rev., D; 6: No. 12, 3506-3512(15 Dec 1972).

Sum rules for the real parts of causal amplitudes are derived in the quark-model light-cone algebra. (auth)

15858 SU(2) MASS SPLITTING IN THE VECTOR MIXING MODEL. Inaoka, K.; Yamazaki, T. (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1581-1595(Nov 1972).

The SU(2) mass splitting and mixing of the pseudoscalar and vector mesons are investigated in connection with SU(3) breaking, under the assumption that the divergent self-energies caused by the vector mixing $\phi_\mu^{(0)}\phi_\mu^{(8)}$ and $\phi_\mu^{(0)}\phi_\mu^{(3)}$ yield the tadpole-like mass splitting. The calculated values of $\Delta I = 1$ mass splitting and mixing are in good agreement with experiment. It is remarkable that our model unlike the conventional tadpole model gives a consistent value of $m^2_{K^0}-m^2_{K^\pm}$, and that the decay rates $\eta \rightarrow 3\pi$ and $\omega \rightarrow 2\pi$ estimated by using the calculated transition masses are consistent with experiment. The observed value of $m^2_{K^{*0}} - m^2_{K^{*\pm}}$ and the tendency $m^2_{\rho^0} - m^2_{\rho^\pm} > 0$ are reproduced by a large value of the magnetic moment. (auth)

15859 SUBTRACTION PIECE IN THE COTTINGHAM FORMULA FOR THE p–n MASS DIFFERENCE. Muta, T. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1596-1605(Nov 1972).

The possible absence of the J = 0 and I = 1 fixed-pole and A_2 Regge-pole terms in the longitudinal part of the p–n difference of the forward virtual Compton amplitude, ΔT_L, at least in the Bjorken scaling limit is discussed. An unsubtracted dispersion relation for ΔT_L is written down to show that the condition for the Cottingham formula to converge is $R \sim q^2/2\nu^2$ in the scaling limit. The deep inelastic contribution to the p–n mass difference is estimated by use of the recent experimental data and is found too small to be able to reverse the wrong sign unless a parameter appearing in the expression for R is large negative. (auth)

15860 SCATTERING OF VERY HIGH ENERGY PARTICLES FROM LIGHT NUCLEI. Czyz, W. (Inst. of Nuclear Physics, Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 143-144(1969).

An attempt is made to give a coherent interpretation of the experimental results on scattering of nucleons and electrons from nuclei. For this interpretation the Glauber model for the high energy multiple scattering of particles from complex targets is used. The possibility of obtaining information on the amplitude of the elementary particle process is discussed. (JFP)

15861 NUCLEON ELECTROMAGNETIC MASS DIFFERENCE AND INELASTIC ELECTRON SCATTERING. Morishita, Norikazu (Chubu Inst. of Tech., Aichi, Japan). Mem. Chubu Inst. Technol.; 7: 137-141(Dec 1971).

The p–n mass difference is considered on the basis of a dispersion theory. The inelastic and Regge contributions are evaluated by using the $T_1(q^2,\nu)$ dispersion relation subtracted at $\nu = 0$, predictions of the vector-meson dominance model for inelastic electron-nucleon scattering, and total photoproduction cross sections of the proton and neutron given by simple Regge pole fits of the experimental data. Thus $\delta M^{inel}(p\text{-}n) + \delta M^{Regge}(p\text{-}n) \simeq 0.4$ MeV is found. (auth)

15862 POINT-LIKE HADRONS FROM COLLIDING BEAMS. Ingraham, R. L. (New Mexico State Univ., Las Cruces). Int. J. Theor. Phys.; 6: No. 3, 175-179(Oct 1972).

It is recalled that a frame-dependent cut-off in field theory has predicted the phenomenon apparently observed in $e^+e \rightarrow 2$ hadrons in colliding beams, namely that (hadronic or semi-hadronic) cross sections $d\sigma/dt$ directly measured in the CM frame should be different (in general, larger) than those measured in the lab frame at sufficiently high energies. A rough calculation shows quantitative agreement with the preliminary data. (auth)

15863 ABSENCE OF THE DIP IN BACKWARD π^+ PHOTOPRODUCTION USING A NARROW RESONANCE MODEL. Lee, P. (Univ. of Toronto). Can. J. Phys.; 50: No. 21, 2647-2653(1 Nov 1972).

The absence of the dip in backward π^+ photoproduction is examined with both the "$N_\gamma - N_\alpha$ exchange degeneracy coupled with duality" and the "$I = 3/2$ dominance" points of view. A uniform combination of beta functions is employed using no arbitrary satellite terms but including parity doublets of the N_α, N_γ, and Δ_δ trajectories. (auth)

Weak

Refer also to abstract 15953.

15864 (ITF-72-142-E) MODEL OF LEPTONS BASED ON THE THREE DIMENSIONAL UNITARY GROUP. Sato, H. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 15p. Dep. NTIS (U. S. Sales Only).

Finite theory of electromagnetic and weak interactions of leptons is formulated based on the three-dimensional unitary group. On the basis of Konopinski–Mahmoud type assignment of quantum numbers to leptons, one obtains the natural formulation of symmetries of leptons, and one can introduce electrons and muons into the theory in a unified way. The results reproduce Weinberg's model. (auth)

15865 (JINR–D1-6349, pp 496-506) NUCLEAR EFFECTS IN HIGH ENERGY NEUTRINO REACTIONS. Franzinetti, C. (Univ., Turin).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

A summary is given of various studies on nuclear effects in high-energy neutrino interactions in nuclei. Topics covered include: incoherent elastic scattering of neutrinos in nuclei; excitation of nuclear giant dipole resonant states; inelastic reactions in nuclei; and pseudoscalar meson dominance and nuclear effects. (LBS)

15866 NONLEPTONIC WEAK DECAYS AND SU_3 BREAKING OF THE STRONG-COUPLING CONSTANTS. Gavroglu, K. (Imperial Coll. of Science and Tech., London). Lett. Nuovo Cim.; 5: No. 18, 1109-12(30 Dec 1972).

The close connection between the parity-conserving amplitudes of the weak nonleptonic decays and the strong-coupling constants, as exhibited by the quark density model, is used to study the deviations of the strong-coupling constants from their SU(3) values. The values of the coupling constants from fits to p-wave amplitudes are shown to be in good agreement with experiment. (LBS)

15867 $K\pi$-SCATTERING PHASE SHIFT AND K_{l3}-FORM FACTORS. Kaneko, T. (Meijo Univ., Nagoya, Japan); Watanabe, K. Progr. Theor. Phys. (Kyoto); 48: No. 5, 1683-1692 (Nov 1972).

K_{l3} form factors are calculated by means of the dispersion rela-

tion with the recent experimental Kπ scattering phase shifts. The result of the overall fit of K_{l3} decay is investigated. Cross sections for the neutrino reaction processes $\nu + \pi \rightarrow K + l$ and $\nu + \bar{K} \rightarrow \pi + l$ are calculated using the form factors determined from K_{l3}-decay processes. (auth)

15868 DIAGONAL PART $(\mu\nu_\mu)(\bar{\nu}_\mu\mu)$ IN THE THEORY OF LEPTONIC WEAK INTERACTIONS. Koike, K.; Konuma, M.; Kurata, K.; Sugano, K. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1761-1762(Nov 1972).

A method is proposed to compare the strength of the interaction $(\bar{\mu}\nu_\mu)(\bar{\nu}_\mu\mu)$ with that of $(\bar{\mu}\nu_\mu)(\bar{\nu}e)$, treating the process of neutrino production of lepton pairs in the electromagnetic field of the nucleus. Angular correlations for $\nu_\mu + z \rightarrow z + \mu^- + \mu^+ + \nu_\mu$ in the coplanar case are given for the incident momentum 1, 10, and 100 GeV/c and the target ^{56}Fe. Comparison is made with a previous calculation for $\nu_\mu z \rightarrow z\mu^- e^+ \nu_e$. (LBS)

Strong (General)

15869 (JINR-D1-6349, pp 3-26) TESTS OF THE MODEL OF MULTIPLE DIFFRACTIVE SCATTERING. Czyz, W. (Inst. of Nuclear Physics, Krakow).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The model of multiple diffraction scattering is first described and is illustrated for hadron-nucleus scattering, the collision of two composite objects, and potential scattering. Comments are made on some recent data and calculations, and it is concluded that the experimental data published so far still support the model. It is also pointed out that quantum electrodynamics gives considerable support to the physical content of the model. Inelastic shadowing effects in diffraction production are also discussed. (LBS)

15870 ππ-, πK-, AND KK̄-DISTRIBUTIONS IN THE PIONIZATION REGION. Sakai, S. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1636-1651(Nov 1972).

Two-particle distributions are investigated in the multiperipheral model which has succeeded in fitting single-particle distributions. The two particle distribution functions in the pionization region are investigated. The results show that there is a cutoff with respect to $k_{1\perp}^2$, $k_{2\perp}^2$, and $(k_{1\perp} + k_{2\perp})^2$, where k_1 and k_2 are four momenta of produced particles. The results indicate that the correlations are stronger in ππ- than in KK̄-channel and the correlation has the $k_\perp^2$ dependence. In other words the stronger correlations are seen in the small $k_\perp^2$ region than in the large $k_\perp^2$ region. Comparison with the experimental data on longitudinal rapidity distributions and rapidity correlations are also discussed. The qualitative features agree with the result. (auth)

15871 MULTIPLE PRODUCTION. Arafune, J.; Sugawara, H. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1652-1673(Nov 1972).

The total and the pion multiplicities are calculated based on the multi-Regge model. The result shows that the pion multiplicity is an order of magnitude smaller than the observed value. The total multiplicity is also extremely small. Discussions including the extension of the Pomeranchuk theorem to inclusive reactions are also presented. (auth)

15872 EXPLICIT SUM OF STRONGLY ABSORBED ONE-PARTICLE EXCHANGES WITH SPIN J FROM 1 TO ∞. Ingraham, R. L. (New Mexico State Univ., Las Cruces). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1674-1682(Nov 1972).

One-particle exchanges of spin J, strongly absorbed by suppressing low partial waves, are explicitly summed from J = 1 to ∞ by the Sommerfeld-Watson method. In the resulting high energy elastic (nondiffractive) amplitude, $f \propto s^{\alpha - \frac{1}{2}} J_0(R\sqrt{-t})$, the presence of the Bessel-like function of momentum transfer is wholly due to the absorption. A linear mass trajectory and vanishing widths for the exchanged boson resonances are preferred. (auth)

15873 NOTES ON SOME APPLICATIONS OF MORAVCSIK'S PARTIAL WAVE ANALYSES. Yamaguchi, Y. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1755(Nov 1972).

Comments are made on Moravcsik's partial-wave analysis of high-energy hadron-hadron scattering in which a large number of partial waves participate in scattering processes. The comments are related to the use of two different smooth functions; one-pion-exchange contributions; and application to heavy ion-nucleus scattering. (LBS)

15874 FORMAL DESCRIPTION OF TRIALITY SELECTION RULE BY MEANS OF BOSON OPERATOR. Ito, D. (Instituto de Fisica Teorica, Sao Paulo, Brazil). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1764-1765(Nov 1972).

A formal-method of describing the triality selection rules by means of boson operators is presented. (LBS)

15875 ALGEBRAIC FORMULATIONS OF DYNAMICAL THEORIES OF THE COMPOSITE SYSTEMS WITH MASS SPLITTING. Olszewski, Jan (Jagellonian Univ., Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 31-38 (1969).

A lecture is given on hadron compound structures with mass splitting. The main ideas and results of the work of Fronsdal including the construction of the field theory with infinite number of components, relativistic wave equations with various mass spectra, and transformation of the nonrelativistic theory of the hydrogen atom into the form of the local infinite-component field theory are reviewed. Some representations of the SO(p,1) algebras, Fronsdal results on infinite-component field theory, and wave equations with mass splitting are covered. (JFP)

15876 SOME ASPECTS OF THE QUARK MODEL. Werle, J. (Univ., Warsaw). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 17-19(1969).

Various aspects of the quark model are reviewed including the assumptions, main difficulties, and applications. (JFP)

Strong (Baryon No. = 0)

Refer also to abstract 15815.

15877 (DESY-72/53) NONANALYTIC TERMS AND THE EVALUATION OF c IN THE $(3,\bar{3}) + (\bar{3},3)$ MODEL. Cornwell, D. T. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sep 1972. 12p. Dep. NTIS (U. S. Sales Only).

The parameter c of the $(3,\bar{3}) + (\bar{3},3)$ model has been evaluated in the past in various ways. More recently Li and Pagels have pointed out the presence in amplitudes of terms nonanalytic in the chiral breaking parameter. The effects of such terms on evaluations of c are considered. (auth)

15878 (DESY-72/62) GENERALIZED VECTOR MESON DOMINANCE OF ELECTROMAGNETIC INTERACTIONS IN A RELATIVISTIC QUARK MODEL. Boehm, M.; Joos, H.; Krammer, M. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1972. 9p. Dep. NTIS (U. S. Sales Only).

The vector meson-current coupling constants γ_V of higher-mass vector mesons occurring in a relativistic quark model are calculated. It is found that the higher vector mesons, on the average, generate a point-like cross section for $\sigma^{tot}(e^+e^- \rightarrow \text{hadrons})$. (auth)

15879 DETERMINATION OF THE SCATTERING AMPLITUDE FROM THE DIFFERENTIAL CROSS-SECTION AND UNITARITY. Atkinson, D. (Univ., Groningen, Netherlands); Johnson, P. W.; Warnock, R. L. Commun. Math. Phys.; 28: No. 2, 133-58 (1972).

When the differential cross section for spin-zero elastic scattering is given, the elastic unitarity condition constitutes a nonlinear integral equation for the phase of the scattering amplitude. Existence and uniqueness theorems for solutions of the equation were obtained by Newton and Martin. Some improvements of the Newton-Martin results on uniqueness and iterative construction of solutions are obtained. Certain details of rigour in the applications of Schauder's theorem by Newton and by Martin are supplied. The case of inelastic spin-zero scattering is treated by adding a term to the unitarity condition to account for absorption. It is shown that in the inelastic region one may have infinitely many different scattering amplitudes with a given differential cross section. This result is potentially important in phase-shift analysis, since it means that there is a "continuum ambiguity" in the determination of phases and elasticities from scattering data. (auth)

15880 INTERACTION OF ISOVECTOR SCALAR MESONS WITH A STATIC SOURCE. Bolsterli, M. (Los Alamos Scientific Lab., NM). Phys. Rev., D; 6: No. 12, 3501-3505(15 Dec 1972).

A self-consistent method is used to find an approximate ground state in the case of charged scalar and isovector scalar static source theories. In both cases there is a spectrum of stable excited states. In the case of a point source, the physical states are grouped into orthogonal uncoupled subspaces. (auth)

15881 MULTIPLICITY DISTRIBUTION IN THE MULTIPERIPHERAL MODEL AND A ONE-DIMENSIONAL GAS. Lee, T. D. (Columbia Univ., NY). Phys. Rev., D; 6: No. 12, 3617-3630(15 Dec 1972).

The multiplicity distribution at high energy in the multiperipheral model for the ϕ^3 theory is shown to be identical to the grand canonical ensemble distribution of a particular one-dimensional gas with only repulsive forces, which can be decomposed into two-body, three-body, and other multibody forces. The specific form of these forces and the corresponding virial expansion of the gas system are discussed. An alternative systematic expansion method is developed which is different from the virial series but appears to be of a greater practical value for this particular class of physical problems. (auth)

15882 NUCLEON LOOP AS A FORCE IN THE $\pi\pi$ CHANNEL. Gutbrod, F. (DESY, Hamburg). Phys. Rev., D; 6: No. 12, 3631-3640(15 Dec 1972).

The ρ meson is described as a $\pi\pi$-$N\bar{N}$ composite system, with N exchange as a nondiagonal force between the two channels. The resulting nucleon loop, as a force in the $\pi\pi$ channel, gives far too strong attraction, if calculated with unmodified nucleon propagators. The necessary cutoff parameter in the nucleon propagators is compared with the same quantity obtained in the $\Delta(1236)$ channel. Pion self-energy effects are introduced to improve the resulting ρ width, and crossing properties of the $\pi\pi$ p waves are discussed. (auth)

15883 COHERENT INTERACTIONS AT HIGH ENERGY. Bialas, A. (Jagellonian Univ., Krakow). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 35-37(1968).

In this lecture the coherent effects in high energy two-body reactions of spinless particles are treated. (JFP)

15884 DYNAMICAL THEORY OF QUARKS. Rayski, J. (Jagellonian Univ., Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 9-11(1969).

A dynamical theory of quarks is described in which systems of two quarks repel each other and systems of three quarks attract each other. Computations for meson and baryon multiplet and quark masses are in progress. (JFP)

15885 DECAY LAWS FOR UNSTABLE PARTICLES. Lukierski, J. (Univ., Wroclaw). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 39-47(1969).

A lecture is given on a description of the simplest unstable systems emphasizing their decay laws. The relativistic and nonrelativistic cases for the unstable state as the superposition of stable states and the operator formulation of unstable particle theory are treated. (JFP)

15886 ENERGY DEPENDENCE OF THE EFFECT OF ANGULAR CORRELATIONS IN $\bar{p}p$ ANNIHILATIONS. Czyzewski, O. (Inst. of Nuclear Research, Krakow); Szeptycka, M. Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 87-93 (1969).

The energy dependence of the angular correlation discussed by Goldhaber et al who found a marked difference between the distributions of the opening angle for the pairs of pions of like and unlike charges in $\bar{p}$ + p annihilations at 1.05 GeV/c is discussed. (JFP)

15887 ANGULAR CORRELATION BETWEEN PIONS IN THE ANNIHILATION AT REST $p\bar{p} \rightarrow \pi^+\pi^+\pi^-\pi^-$. Zalewski, K. (Inst. of Physical Chemistry, Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 95-105(1969).

It is pointed out that if the mechanism of Goldhaber et al is really responsible for the observed effect of the angular correlation between pions in $\bar{p} + p \rightarrow 2\pi^+ + 2\pi^-$ annihilations at rest, then in the framework of the uncorrelated jet model one is led to the conclusions for one-particle amplitudes in momentum space that identical particles have different one-particle amplitudes and that the phases of the one-particle amplitudes are rapidly varying functions of pion momenta. (JFP)

Strong (Baryon No. = 1)

Refer also to abstract 15981.

15888 (UCR-34-P-107-B-126) PARTIAL WAVE ANALYSIS OF $\pi^+p \rightarrow \pi^0\Delta^{++}$ AT 1.8 TO 2.1 GeV. Mehtani, U.; Fung, S.Y.; Kernan, A.; Williamson, Y. (California Univ., Riverside); Birge, R. W.; Kalmus, G. E.; Michael, W. (California Univ., Berkeley. Lawrence Radiation Lab.). 1971. 8p. (CONF-710609-16). Dep. NTIS.

From International conference on elementary particles; Amsterdam, Netherlands (30 Jun 1971).

Partial wave analysis of $\pi^+p \rightarrow \pi^0\Delta^{2+}$ at 1.8 to 2.1 GeV shows that this reaction is dominated by $F_{37}(1950)$, for which $\chi_{\pi N}\chi_{\pi\Delta} = 0.24^{+0.01}_{-0.03}$ is found. (auth)

15889 QUANTUM FIELD THEORIES WITH SHADOW STATES. II. LOW-ENERGY PION–NUCLEON SCATTERING. Sudarshan, E. C. G. (Univ. of Texas, Austin); Nelson, C. A. Phys. Rev., D; 6: No. 12, 3678-3688(15 Dec 1972).

By adapting the methods of the first paper, the concepts of shadow states and indefinite metric are used to construct a simple static theory of low-energy pion-nucleon scattering. This theory of s- and p-wave scattering so constructed is both finite and exactly soluble. Scattering at negative energy also is a well-defined process. The calculated scattering amplitude is found to satisfy the substitution law and to be covariant, unitary, and analytic in almost all neighborhoods of physical scattering energies. When given the masses and coupling constants as input, this theory predicts the scattering phase shifts in agreement with experiment. The present limits on the s-wave pion-nucleon scattering total cross sections are compatible with the induced cusps from the opening up of the pseudothreshold of the shadow states. (auth)

15890 $\pi\pi$ SCATTERING AND THE πN σ TERM. Auvil, P. R. (Northwestern Univ., Evanston, IL); Brehm, J. J.; Prasad, S. C. Phys. Rev., D; 6: No. 12, 3526-3530(15 Dec 1972).

The methods of an earlier work are modified so that the unitarity constraints on the $\pi\pi$ amplitude are better satisfied. The modification permits an examination of the extent to which $\pi\pi$ scattering affects the determination of the σ term in πN scattering. (auth)

15891 ANALYTIC CONTINUATION OF REDUCED PION–NUCLEON PARTIAL-WAVE AMPLITUDES. MacDowell, S. W. (Yale Univ., New Haven). Phys. Rev., D; 6: No. 12, 3512-3515 (15 Dec 1972).

It is shown that the partial-wave amplitudes $h_l^+ = (2k^2/4\mu^2)^{-1} f_l^+$ and $h_{l+1}^- = (2k^2/4\mu^2)^{-1} f_{l+1}^-$ can be written for meson-nucleon scattering as $h_l^+ = h_{l,I}^+ + h_{l,II}^+$, where $h_{l,I}^+$ is analytic in the l plane except for fixed poles at negative integers, and $h_{l,II}^+$ is analytic in the energy W complex plane except for cuts which do not disconnect the plane. Moreover, $h_{l,II}^+(W) = -h_{l+1,II}^-(-W)$. Consequences of this result are discussed, in particular its relevance for the theory of Regge poles and the problem of the uniqueness of Mandelstam amplitudes for meson–nucleon scattering. (auth)

15892 DIFFRACTIVE N* PRODUCTIONS IN THE QUARK MODEL. Kobayashi, T.; Nakamaru, N.; Saito, K. (Tokyo Univ. of Education). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1618-1635(Nov 1972).

Diffractive productions of N* with $I = \frac{1}{2}$ are investigated on the basis of a quark model with a relativistic extended internal structure. Momentum transfer dependences of differential cross sections ($d\sigma/dt$) at low momentum transfers are consistently reproduced. At high momentum transfers the experimental relations $(d\sigma/dt)(Xp \rightarrow XN^*)/(d\sigma/dt)(Xp \rightarrow Xp) \xrightarrow{|t| \rightarrow \text{large}}$ const are also satisfied, where $X = \pi$ and p. As for the absolute value of $d\sigma/dt$, consistent values for $N^*_{15}(1688)$ can also be obtained but values smaller than the experimental ones are given for $N^*_{11}(1470)$ and $N^*_{13}(1525)$. The so-called s-channel helicity conservation can be predicted for the elastic scattering and forward production processes of N* belonging to the 56-dimensional representation $\{56\}$ of the SU(6) symmetry. On the other hand for N* in the $\{70\}$ it is not true. Morrison's rule for diffractive scattering, that is, the relation $(-1)^{J_f - J_i} = P_i \cdot P_f$ is shown to be broken in our model. It is also pointed out that the ratios of the helicity flip amplitudes to the helicity nonflip ones $|F_{+-}/F_{++}|$ are an interesting test for determining the spin-unitary spin structures of N*. (auth)

15893 BILOCAL WAVE EQUATION FOR BARYONS LYING ON LINEAR TRAJECTORIES AND ITS EXTENSION TO A LINEAR CHAIN MODEL. Takabayasi, T. (Nagoya Univ., Japan). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1718-1741(Nov 1972).

A new bilocal wave equation for baryonic states is presented. It is a first-order differential equation containing three independent Dirac matrices, one of which is associated to the internal extension. The presence of three Dirac matrices assimilates three quark spins. The wave equation represents baryonic states lying on parallel linear trajectories. From the requirement for the existence of conserved current the model predicts that the intercept of the leading trajectory should be less than 1/2, in accord with observation. The corresponding biolocal theory for mesons requiring the introduction of two independent Dirac matrices is stated briefly. The generalization to the linear multilocal case which represents a one-dimensional chain consisting of N discrete points is performed and is analyzed by the aid of normal mode expansion. The strong and electromagnetic interactions can be introduced to the model, though the theory is still at the non-second-quantized level. In the limit $N \rightarrow \infty$ the chain model goes over to the "double Dirac string model" which is relevant to derivation of the dual

amplitude, and this limiting transition from the discrete to the continuous case clarifies the boundary conditions and other subtleties for the latter model. (auth)

15894 DUALITY AND BESSEL-FUNCTION MODEL FOR $\pi^- p \rightarrow \pi^0 n$ FROM THE REGGE-THEORY VIEWPOINT. Itabashi, K. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1606-1617(Nov 1972).

From the viewpoint of the Regge theory with absorption corrections, the plausibility of Bessel-function model is examined for the case of near-forward πN charge exchange scattering at high energies. As concerns the imaginary part of the helicity-flip amplitude, the approximate equivalence of Regge theory and dual absorptive model (in their dependence on both s and t) is confirmed. This may be regarded as a verification of the duality ansatz combined with the observed approximate constancy (~1 fm) of effective impact parameters of πN resonating channels (the "generalized Ogawa's rule" named by the Kyushu group). For the helicity-nonflip amplitude, a possibility of existence of an additional Bessel component with smaller radius R ~ 0.3 fm is suggested. A rough model-amplitude based on this "two-component peripherality" is given and compared with experiments. (auth)

15895 CROSSING RELATIONS. Svensson, B. E. Y. (Univ., Lund, Sweden). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 25-33(1968).

Crossing relations for the scattering amplitude in two-body elementary particle reactions are discussed using the reduction technique in field theory. The crossing relations as formulated are valid without any assumption on time reversal invariance. (auth)

15896 HIGH MULTIPLICITY PION PROTON INTERACTIONS IN THE GeV REGION. Bartke, J. (Inst. of Nuclear Research, Krakow). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 75-84(1968).

A review is given of high multiplicity pion–proton interactions covering the experimental data on angular and momentum distributions of secondary particles and the production of resonant states and the existing theoretical models. (JFP)

15897 PERIPHERAL MODEL WITH ABSORPTION. Kotanski, A. (Jagellonian Univ., Krakow). Zest. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 9-14(1968).

The review of the peripheral model with absorption covers the Born-term model and the absorption model. Some applications and results are also briefly reviewed for π + N interactions. (JFP)

15898 SIMPLE MODEL OF HIGH MULTIPLICITY, HIGH ENERGY INTERACTIONS. Bialkowski, G. (Univ., Warsaw); Sosnowski, R. Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 115-119(1969).

A lecture is given on the proton four momentum transfer distribution for $\pi^+ + p \rightarrow p + 3\pi^+ + 2\pi^- + \pi^0$ interactions at 8 GeV/c using a simple model. (JFP)

15899 PARTON-CHAIN MODEL OF THE NUCLEON. Krolikowski, W. (Univ., Warsaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 20: No. 8, 689-694(1972).

A simple parton model of the nucleon is proposed, where partons (quarks and gluons) are correlated in such a way as if they formed alternating chains of quarks and gluons. Under reasonable assumptions about the probability of parton configurations one gets a good agreement with experimental data. (auth)

15900 BIPERIPHERAL MODEL. Bialkowski, G. (Univ., Warsaw). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 21-29(1969).

A lecture is given on the main features of the strong interactions of the type 2 → 3 particles using the model with three vertices joined by two internal lines called the biperipheral model. As an example the process $\pi^+ + p \rightarrow N^{*++} + 2\rho^0$ is discussed. The total and differential cross sections and form factors are considered. (JFP)

15901 ORBITAL ANGULAR MOMENTA IN HIGH ENERGY INTERACTIONS AND THE VAN HOVE OVERLAP FUNCTION. Michejda, L. (Inst. for Nuclear Research, Warsaw). Zesz. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 135-141(1969).

The Van Hove overlap function is calculated from orbital angular momenta in $\pi^+ + p$ elastic and inelastic interactions at 8 GeV/c. (T)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 15820, 15977, 16034, 16225, 16234, and 16262.

15902 (INR-P-1351/7/PH) SEPARABLE MODEL FOR HYPERON–NUCLEON INTERACTIONS. Wycech, S. (Institute of Nuclear Research, Warsaw (Poland)). 1971. 17p. INIS.

A separable, two channel, potential model is used to describe hyperon nucleon reactions. The parameters of the potential are set to reproduce the low energy sigma (lambda) nucleon scattering, hypernuclear data and the virtual bound state of the sigma and nucleon. (auth)

15903 (JINR-D1-6349, pp 27-36) DIVERGENCE FROM GEOMETRIC OPTICS AND CALCULATIONS OF NUCLEON RECOIL IN SCATTERING PROCESSES IN GLAUBER THEORY. Kolybasov, V. M. (Inst. of Theoretical and Experimental Physics, Moscow). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Corrections to the Glauber formula for the amplitude of elastic πd-scattering are discussed. Such scattering arises in a propagator of π-meson of "small" terms which ordinarily would be rejected when the propagator is brought to an eikonal form. Some of these correspond to deviations from geometric optics; others to nucleon recoil during scattering. (KSW)

15904 (JINR-D1-6349, pp 267-82) DYNAMICS OF HADRONIC ATOMS. Ericson, T. E. O. (CERN, Geneva).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The atomic life cycle of hadronic atoms is discussed in terms of three phases: molecular and chemical processes, pure electromagnetic phenomena, and strong interaction with the nucleus. (LBS)

15905 (JINR-D1-6349, pp 283-309) HADRONIC ATOMS. Backenstoss, G. (Univ., Karlsruhe, Ger.).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Various properties of hadronic atoms are reviewed. Strong interaction effects for K-mesonic atoms, π-mesonic atoms, Σ-hyperonic atoms, and antiprotonic atoms are discussed. (LBS)

15906 (JINR-D1-6349, pp 310-46) NEW NUCLEUS-LIKE SYSTEMS AND MULTIBARYON RESONANCES. Shapiro, I. S. (Inst. of Theoretical and Experimental Physics, Moscow). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Nucleus-like systems with extremely short lifetimes (of the order of magnitude as the life of particle-resonances) were examined. Systems which contained antinucleons in addition to nucleons (quasinuclear mesons $N\bar{N}$) included a discussion of some qualitative features of quasinuclear mesons not involving complex calculations, and the use of a first approximation of Schroedinger's equation for describing a nonrelativistic system $N\bar{N}$. Energy spectra were considered for the states $N\bar{N}$ (M < 2m), threshold states, (M > 2m), single baryon resonance ($2N\bar{N}$, where M ≤ 3m), and a four-particle quasinuclear meson $2N2\bar{N}$. Nucleus-like many-baryon resonances and the many-baryon Δ-nucleus are discussed. (KSW)

15907 CORRELATION PARAMETERS OF CHARGED PARTICLES IN INCLUSIVE REACTIONS. Baier, R.; Widder, F. (Univ., Graz). Lett. Nuovo Cim.; 5: No. 18, 1133-6(30 Dec 1972).

A model is proposed, which can be solved analytically and which is able to explain a relation for the correlation parameters for negatively charged particles as a function of the mean multiplicity in inclusive reactions. The model is of the single-excitation diffractive type; the cluster coupled to the pomeron (with $\alpha p = 1$) is assumed to decay according to a multiperipheral mechanism with only meson exchange. Theoretical curves are compared with data for pp interactions. It is concluded that the model gives a fair explanation of the data. (LBS)

15908 Δ–d BOUND STATES ($J = \frac{1}{2}, \frac{3}{2}$) AND FADDEEV'S APPROACH TO THE THREE-BODY PROBLEM. Choudhury, H. R.; Gautam, V. P. (Indian Association for the Cultivation of Science, Calcutta). Phys. Rev., C; 7: No. 1, 74-79(Jan 1973).

The binding energy problem of ${}^{4}_{\Lambda}H$ in the ground state and in a possible excited state was investigated in the light of the recent experimental and theoretical results available for the low-energy parameters of Λ–nucleon interaction. The calculations were performed in Faddeev's formalism with two-body nonlocal separable potentials between pairs of particles, two of which are of unequal masses. For each of the sets of Λ–N potentials, the binding energy of the Λ particle within the hypertriton was evaluated. One

of the results for the binding energy of the hypertriton in an excited state ($J = 3/2$) is in reasonably good agreement with that of other authors. The possible qualitative effects of charge-symmetry breaking in the $\Lambda-N$ interaction are discussed in relation to the quantitative comparisons of the Λ binding energies. (1 figure, 1 table) (auth)

15909 REACTION-MATRIX CALCULATIONS OF THE LAMBDA-PARTICLE BINDING IN NUCLEAR MATTER FOR CENTRAL LAMBDAN POTENTIALS. Bodmer, A. R. (Argonne National Lab., IL); Rote, D. M. Nucl. Phys.; No. 1, 145-178 (1973).

Extensive results, obtained in the G-matrix approximation for a wide range of central ΛN Yukawa potentials both with hard cores (HC) and soft repulsive cores, are presented for the Λ well depth (binding energy of a Λ-particle in nuclear matter) and related quantities. The HC results, in particular, span a wide range of scattering lengths a, effective ranges r_0 and hard-core radii c, sufficient to include any potentials likely to be proposed. The s-state well depth D_s is to a good approximation determined by a, r_0 and the s-state correlation volume (wound integral) κ_s^{NM} which characterizes the core in an effectively shape-independent way. The depth D_s decreases with κ_s^{NM} for given a, r_0. A successful search was made for a "scattering" parameter κ_s^{SC} which also characterizes the core in a shape-independent way but which is determined only by (low energy) s-wave scattering calculations; κ_s^{SC} is the (zero-energy) scattering correlation volume up to the separation distance d. The parameterization of D_s in terms of a, r_0 and κ_s^{SC} is then effectively universal for local potentials, permitting one to obtain D_s for any reasonable local potential by use only of s-wave scattering calculations. The p-wave depth D_p is generally quite large with only a moderate dependence on c for given a and r_0 but a strong dependence on r_0. The p-wave correlation volume is not a useful shape-independent parameter for D_p. The d-wave depth is quite small although not negligible. Limited results are obtained for the dependence on density. The implications of a comparison of the calculated and the phenomenological well depths for the ΛN interaction are discussed. (auth)

15910 SEPARABLE POTENTIAL MODEL FOR N–N INTERACTION. II. Sirohi, A. P. S.; Srivastava, M. K. (Univ. of Roorkee, India). Nucl. Phys.; A201: No. 1, 66-80(1973).

A two-term separable potential model for the N–N interaction in $^1S_0$, $^3S_1-{}^3D_1$, $^1D_2$, $^3D_2$, $^3D_3$, $^1P_1$, $^3P_0$, $^3P_1$ and $^3P_2$ partial waves is proposed. Its off-energy-shell behavior is very similar to that of a local potential. (auth)

15911 CONSTRUCTION OF A NUCLEON–NUCLEON POTENTIAL WITH VERY SOFT CORE (SSC). De Tourreil, R. (Institut de Physique Nucleaire, Orsay, France); Sprung, D. W. L. Nucl. Phys.; A201: No. 1, 193-214(1973). (In French).

A phenomenological local nucleon–nucleon potential was constructed satisfying the following criteria: a high quality fit to two-body bound-state and scattering data up to 350 MeV; the amplitudes of all components are weak in the sense that perturbation theory in nuclear matter converges rapidly; the tensor force in the triplet even state is much weaker than in other potential models. Close agreement is found between Brueckner and perturbation-theory calculations in nuclear matter. The deuteron form factor is well reproduced with $P_D = 5.5\%$. (auth)

15912 t/s SCALING AND CONFORMAL INVARIANCE. Castell, L. (Max-Planck-Institut, Starnberg, Ger.). Lett. Nuovo Cim.; 6: No. 3, 115-116(20 Jan 1973).

The assumptions which lead to the experimental value $\kappa = 8$ for $d\sigma/d\Omega = (1/s)(m^2/s)^\kappa$ for elastic proton–proton scattering are indicated. (JFP)

15913 IS A HYPERISOMER OF $\Lambda-Li^7$ POSSIBLE? Pniewski, J. (Univ., Warsaw); Szymanski, Z.; Davis, D. H.; Sacton, J. Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 145-147 (1969).

It is found that the energy of the $5/2^+$ level in $\Lambda-Li^7$ and therefore the existence of the isomeric state may depend significantly on the presence of tensor and spin-orbit forces in the interaction of a Λ^0 particle with nucleons. (JFP)

15914 WHAT ARE FIREBALLS? Miesowicz, M. (Inst. of Nuclear Research, Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 121-123(1969).

The fireball model for nucleon–nucleon interactions and fireball properties are briefly reviewed. (JFP)

15915 ANALYSIS OF THREE- AND FOUR-BODY HYPERNUCLEI USING TWO-CHANNEL POTENTIALS. Braunschweig, E. D. Boulder, Colo.; Univ. of Colorado (1972). 89p. University Microfilms Order No. 72-25,143.

Thesis.

This study of coupled-channel hyperon-nucleon interactions shows that the sigma-nucleon channel should be used explicitly in determining the spin dependence of low-energy hyperon-nucleon interactions. The previously accepted method assumes the hyperon-nucleon interaction can be represented by an effective single-channel potential having the average lambda-nucleon channel spin dependence. Coupled-channel analyses of the bound hypernuclei $_\Lambda H^3$ and ($_\Lambda H^4$, $_\Lambda He^4$) are made using the sigma-nucleon channel explicitly. Variational calculations are made for hyperon-nucleon potentials, without hard cores, which reproduce these hypernuclear binding energies, giving results significantly different from effective single-channel results. (Diss. Abstr. Int., B)

15916 BINDING ENERGIES OF HYPERFRAGMENTS. Borysowicz, J. (Inst. for Nuclear Research, Warsaw); Dabrowski, J. Zest. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 51-74(1968).

Lectures are given on the ΛN potential determined from the binding energy of $\Lambda-H^3$ and from the binding energy of Λ in nuclear matter. Also the exact theory for the binding energy of $\Lambda-H^3$ is discussed including the integral equations for the wave function of the three-body bound state and the equations for the scattering amplitude in the three-body problem. (JFP)

15917 PARITY-VIOLATING NUCLEAR INTERACTIONS AND MODELS OF THE WEAK HAMILTONIAN. Fischbach, E. (Purdue Univ., Lafayette, IN); Tadic, D. Phys. Rep.; 6C: No. 2, 123-186(Jan 1973).

The derivation of the parity-violating internucleon one-meson-exchange potentials is presented, stressing their connection with models of the weak interactions. Relevant problems concerning second class currents, gauge invariance, off-mass-shell effects, symmetry breaking and multimeson exchanges are discussed. An extensive bibliography of existing literature is also presented. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 15755 and 16249.

15918 (DESY-72/58) NONLINEAR REALIZATION OF CHIRAL SYMMETRIES AND LOCALIZABILITY. Flume, R. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1972. 8p. Dep. NTIS (U. S. Sales Only).

It is proven that the nonlinear realization of $SU(n) \times SU(n)$ ($n \geq 3$) is uniquely determined by the requirement that the Lagrangian, with a minimal number of derivatives of those fields parametrizing the adjoint representation of the diagnonal SU(n) subgroup, is localizable in the sense of Jaffe. (auth)

15919 (ITF-72-118-P) TOPOLOGY OF THE REAL LIE GROUPS OF SMALL DIMENSIONALITY. I. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

A well known classification of the real Lie algebras of dimensionality from 1 to 4 is used to define the Lie groups with these algebras and to investigate their topological structure. (auth)

15920 OKUBO DOMAINS AND THE REPRESENTATION (1,8) ⊕ (8,1) IN THE CHIRAL SYMMETRY. Khelashvili, A. A.; Eliashvili, M. A. (Tbilisi Mathematics Inst., USSR). Soobshch. Akad. Nauk. Gruz. SSR; 68: No. 3, 557-60(Dec 1972). (In Russian).

The possibility of the breaking of the chiral symmetry $SU(3) \times SU(3)$ is discussed when the (1,8) ⊕ (8,1) representation is taken into account together with the (3,3̄) ⊕ (3̄,3) term. The positivity domains of the spectral functions are determined and the influence of (1,8) ⊕ (8,1) term on the Okubo domains is studied. (auth)

15921 UNITARY REPRESENTATIONS OF THE SL(2,C) GROUP. Nguyen Van Hieu (Joint Inst. of Nuclear Research, Dubna, USSR). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 14-23(1968).

A lecture is presented on the irreducible unitary representations of the SL(2,C) group. Also covered are equivalent representations, splitting of infinite dimensional representations into direct sums of representations of the SU(2) group, and trilinear invariant couplings. (JFP)

15922 HARMONIC ANALYSIS AND ITS APPLICATION TO THE ORTHOGONAL AND POINCARE GROUPS. Wolf, K. B. (Univ. National Autonoma de Mexico, Mexico City). Rev. Mex. Fis.; 21: No. 2, 87-113(1972).

The classical construction of the group ring is used to present a pair of harmonic transform functions as the coordinates of a ring element in two different bases: one, a function, F(g), on the group manifold, C; the other, $F_{(j)}$ on the set, S, of unitary irreducible representations (UIR's) of the group. The transformation kernel is given by the UIR matrix elements of the group $D^j(g)$. This mathematical formalism is developed in order to present in a concise fashion several results in relativistic kinematics, Toller's partial wave expansion and some field theories on the Poincaré group. In particular, there are proved for the orthogonal groups three theorems which have direct analogs in Toller's work: functions on spaces of cosets lead to a reduction in the expansion basis; harmonic transformation with respect to a group and one of its subgroups yields a relation between the partial-wave coefficients, familiar from the relation between a Toller pole and its Regge daughter poles; and the (Sciarrino–Toller) factorization of the residues of the former implies a corresponding factorization of the latter. (auth)

Applications (Electromagnetic and Weak)

Refer also to abstracts 16159 and 16250.

15923 INTERPRETATION OF A T = 2 σ COMMUTATOR. Brehm, J. J. (Univ. of Massachusetts, Amherst). Phys. Rev., D; 6: No. 12, 3530-3533(15 Dec 1972).

The circumstance in which the σ commutator, σ^{jk}, has isospin T = 2 as well as T = 0 components is analyzed. These are assigned along with $\partial_\mu A^k_\mu$ to a mixture of $(\frac{1}{2},\frac{1}{2})$ and (1,1) representations, and a recent theoretical result is used to make the assignment quantitative. Addition is made to the Gell-Mann–Oakes–Renner Hamiltonian in order to account for the T = 2 effect. The modification presented as an example is (8,8) transforming, constructed to provide the (1,1) structure in $\partial_\mu A^k_\mu$ and σ^{jk}. (auth)

15924 CP AND CPT NONINVARIANT RELATIVISTIC WAVE EQUATIONS OF THE 2-COMPONENT NEUTRINO. Tekumalla, A. R.; Santhanam, T. S. (Inst. of Mathematical Sciences, Madras). Lett. Nuovo Cim.; 6: No. 3, 99-102(20 Jan 1973).

The noncovariant and spherical factorizations of the Klein, Gordon equation are used to write two-component relativistic wave equations describing the neutrino. It is noted that these equations are CP and CPT noninvariant but T (in the sense of Wigner) invariant. It is shown that a possible CP and CPT violation can well be incorporated in a T-invariant relativistic equation for the neutrino. (JFP)

Applications (Strong)

Refer also to abstract 15866.

15925 (DESY-72/56) BARYON–ANTIBARYON BOOTSTRAP MODEL OF THE MESON SPECTRUM. Schierholz, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Sep 1972. 30p. Dep. NTIS (U. S. Sales Only).

A baryon-antibaryon bootstrap model is presented which, for the meson spectrum, is understood to be an alternative of the quark model. Starting from the baryon octets, the forces are constructed from the t-channel singularities of the nearest meson multiplets and transformed into an SU(3) symmetric potential. At this stage it is assumed that the baryon and meson multiplets are degenerate. Any contributions from the u-channel are neglected for it is exotic and only contains the deuteron. The dynamical equation governing the bootstrap system is the relativistic analog of the Lippmann–Schwinger equation which is an integral equation in the baryon c.m. momentum. The potential is chosen to take account of relativistic effects. Inelastic contributions such as two-meson intermediate states are neglected. Reasons why they must be small are discussed. One is looking for a self-consistent solution of the bootstrap system in which baryon-antibaryon bound state multiplets, to be interpreted as mesons, are forced to coincide with the input meson multiplets. Furthermore, the output coupling constants and F/D ratios have, to a certain extent, to agree with their input values. Practically, it is required that the bootstrap system consists of only a few multiplets, the remainder being decoupled approximately. A self-consistent solution is found comprising scalar, pseudoscalar and vector singlets and octets with masses being in good agreement with their average physical masses. The coupling constants and F/D ratios turn out to be consistent with experiment and other ideas. Possible origins of SU(3) breaking are then investigated. The spontaneous breakdown of SU(3) is ruled out by the fact that the dynamics is stable against small perturbations of the input masses. Instead, a solution of the symmetry breaking is given in terms of bootstrapped singlet-octet mixing. (auth)

15926 (ITF-72-115-E) CROSSING RELATIONS FOR PARTIAL-WAVES, RESULTING FROM AN EXPANSION OF THE SCATTERING AMPLITUDE INTO REPRESENTATION FUNCTIONS OF THE GROUP O(3,C). Kirschbaum, D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 11p. Dep. NTIS (U. S. Sales Only).

The elastic scattering amplitude of two spinless particles of equal mass m can be expanded in terms of functions, which are elements of definite representation spaces of the group O(3,C)[I]. This expansion of f(a,t,u) holds in the whole complex Mandelstam plane a + t + u = $4m^2$ and was used to consider the c.m.f analysis of f(a,t,u) in one channel and the b.w.f analysis in the two other channels. The relations between these expansions (which result from the analytical structure of representation functions of the group (O(3,C)) where also considered. It is shown that the crossing symmetry of the scattering amplitude implies an infinite set of finite-dimensional relations between the partial-wave expansions (the expansion in the c.m.f) of the three channels. These expansions are compared especially in the interior of the Mandelstam triangle, where these relations take a very simple form. (auth)

15927 GENERAL CHIRAL-SYMMETRY BREAKING AND σ TERMS. Turner, L.; Olsson, M. G. (Univ. of Wisconsin, Madison). Phys. Rev., D; 6: No. 12, 3522-3526(15 Dec 1972).

The properties of general chiral-symmetry breaking are systematically investigated in a σ model. Not only the conventional results of nonlinear pion models are obtained, but also the effects of the symmetry breaking upon σ terms. It is shown that the σ terms depend upon the fraction of the pion mass coming from the chirally symmetric part of the model, as well as upon the representation of the symmetry-breaking part of the model. (auth)

15928 IS THE ASSUMED STRUCTURE FOR SU(3) ⊗ SU(3) BREAKING TOO SIMPLE? Sirlin, A.; Weinstein, M. (New York Univ., NY). Phys. Rev., D; 6: No. 12, 3588-3591(15 Dec 1972).

The general features of a model in which the proposed SU(3) ⊗ SU(3) symmetry of the strong interactions is broken by a Hamiltonian belonging to the $(3,\bar{3}) \oplus (\bar{3},3) \oplus (8,8)$ representation of SU(3) ⊗ SU(3). It is shown that the model is capable of reproducing a large range of values for the $\pi-\pi$ scattering length and the $\pi-N$ σ term, while still preserving the idea of small SU(3) ⊗ SU(3) violation. Furthermore, it is demonstrated that, in a natural way, one can require SU(2) ⊗ SU(2) to be a better symmetry than SU(3) ⊗ SU(3). (auth)

Field Theories

General

15929 FIELDS NONLOCAL IN CLIFFORD SPACE. I. CLASSICAL GAUGE-INVARIANT NONLINEAR FIELD THEORY. Danos, M. (National Bureau of Standards, Washington, DC); Greiner, W.; Rafelski, J. Phys. Rev., D; 6: No. 12, 3476-3491 (15 Dec 1972).

A fully gauge-invariant, Lorentz-covariant, nonlocal, and nonlinear theory, for coupled spin-½ fields, ψ, and vector fields, A, i.e., "electrons" and "photons," is constructed. The field theory is linear in the ψ fields. The nonlinearity in the A fields arises unambiguously from the requirement of gauge invariance. The coordinates are generalized to admit hypercomplex values, i.e., they are taken to be Clifford numbers. The nonlocality is limited to the hypercomplex component of the coordinates. As the size of the nonlocality is reduced toward zero, the theory goes over into the inhomogeneous Dirac theory. The nonlocality parameter corresponds to an inverse mass and induces self-regulatory properties of the propagators. It is argued that in a gauge-invariant theory a graph-by-graph convergence is impossible in principle, but it is possible that convergence may hold for the complete solution, or for sums over classes of graphs. (auth)

15930 NEW SOLUTION OF EINSTEIN'S UNIFIED FIELD THEORY. Buchner, K. (Kyoto Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1708-1717(Nov 1972).

A new set of exact solutions to Einstein's Unified Field Theory is found. It has the property that the symmetric part of the connection vanishes globally in some system of coordinates and that arbitrary initial values of the basic tensor g_{ik} can be specified at any given point (complete integrability). The components of the fundamental tensor are polynomials of degree ≤2 in the coordinate system under consideration. For the case of a constant electromagnetic current of length zero, these solutions yield a result different from the General Theory of Relativity. (auth)

15931 PROPAGATION OF AN INTERACTING SPIN ONE FIELD. Jenkins, J. D. (Univ. of Durham, Eng.). Lett. Nuovo Cim.; 6: No. 3, 103-106(20 Jan 1973).

The causal natures of a massive, a vector, and a second-rank antisymmetric tensor spin-1 field propagation in interaction with the Dirac field are compared. It is found that as far as causality is concerned in contrast with the case of interactions with an external electromagnetic field, the vector and antisymmetric second-rank tensor spin-one fields are as good or bad as each other when simple interactions with the Dirac field are considered. (JFP)

Quantum Field Theory

Refer also to abstracts 15833, 15838, 15880, 15963, 15968, 15983, and 16284.

15932 (ITF-72-130-P) NONLOCAL QUANTUM ELECTRODYNAMICS MODEL WITH W-BOSON. Mogilevskii, O. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 25p. (In Russian). Dep. NTIS (U. S. Sales Only).

The electromagnetic interaction of charged leptons and W-bosons is considered. The photon Green function is investigated in the "principal logarithmic diagram" approximation. The requirement for any Feynman diagram, which is calculated by means of this Green function, to be convergent leads to a nonlocal theory. The value of the resulting elementary length is close, in order of magnitude, to the Compton wave length of the W-boson. Comparison with the results obtained earlier in spin electrodynamics enables one to draw the conclusion that the behavior of renormalized and unrenormalized theories at short distances is qualitatively different. (auth)

15933 NONLINEAR SPINOR THEORY OF ELEMENTARY PARTICLES. Naumov, A. I. (Moscow State Univ.). Lett. Nuovo Cim.; 5: No. 18, 1129-32(30 Dec 1972).

Progress on the construction of a theory of elementary particles based on the introduction on only one fundamental spinor field with self-action is reported. A unitary-invariant form-fermion model of elementary particles with an indefinite metric is considered. Results are obtained for meson and baryon masses. It is noted that the results obtained on the basis of the new propagator of the unitary invariant Lagrangian and of the modified perturbation method seem to be very satisfactory and promising. (LBS)

15934 FUNCTIONAL METHODS AND MODELS IN QUANTUM FIELD THEORY. Fried, H. M. Cambridge, MA; Massachusetts Institute of Technology Press (1972). 223p. $8.95.

A description of the major soluble and approximate models of relativistic quantum field theory is presented from the unified view point. Functional methods are considered covering the generating functional and the S-matrix, construction of the generating functional, noncanonical chiral generalizations, and special topics in quantum electrodynamics. Also model approximations are discussed covering perturbation expansions, soluble models, no-recoil methods, relativistic eikonal physics, and speculations at high energy. (JFP)

15935 QUANTUM FIELD THEORIES WITH SHADOW STATES. I. SOLUBLE MODELS. Nelson, C. A. (Louisiana State Univ., Baton Rouge); Sudarshan, E. C. G. Phys. Rev., D; 6: No. 12, 3658-3678(15 Dec 1972).

To construct a finite local relativistic quantum field theory an indefinite-metric vector space may be introduced, but then to avoid conflict with unitarity only a selected subset of states to be physical must be considered. The remaining states participate in the dynamics but are not among the complete set of physical states as far as probability interpretation is concerned. These states are called shadow states. The S matrix should be unitary when restricted to the physical states. Several simple models of field theories with shadow states are formulated and solved and the manner in which shadow states influence the dynamics and the structure of the scattering amplitude is demonstrated. The choice of a standing-wave boundary condition for the shadow states is shown to be completely consistent with the physical description of the scattering process in terms of wave packets. These methods are adapted to the study of low-energy pion-nucleon scattering. (auth)

15936 ANOMALY OF THE AXIAL-VECTOR CURRENT IN ONE SPACE AND ONE TIME DIMENSION. Shei, S. S. (Cornell Univ., Ithaca, NY). Phys. Rev., D; 6: No. 12, 3469-3475(15 Dec 1972).

Wilson's theory of broken scale invariance is used to study the anomaly of axial-vector current in a world with one space and one time dimension. It is shown that in the Schwinger and Thirring models, Wilson's approach and the perturbative approach yield similar results for the anomaly of partial conservation of axial-vector current. (auth)

15937 SOLUTIONS OF THE BETHE-SALPETER EQUATION IN THE INFINITE-MOMENTUM LIMIT. De, T.; Kim, Y. S. (Univ. of Maryland, College Park). Phys. Rev., D; 6: No. 12, 3689-3695(15 Dec 1972).

A method is presented for solving the O(3)-invariant integral equation which Kim and Zaoui obtained by taking the infinite-momentum limit of the Bethe-Salpeter equation. A partial-wave decomposition is made for this O(3)-invariant integral equation. A variational method is then developed to solve the resulting radial equation. The solutions of the present analysis give a mass-coupling-constant relation different from that of the solutions obtained by the conventional O(4) method. (auth)

15938 MASSLESSS, EUCLIDEAN QUANTUM ELECTRODYNAMICS ON THE 5-DIMENSIONAL UNIT HYPERSPHERE. Adler, S. L. (Inst. for Advanced Study, Princeton, NJ). Phys. Rev. D; 6: No. 12, 3445-3461(15 Dec 1972).

It is shown that the Feynman rules for vacuum-polarization calculations and the equations of motion in massless, Euclidean quantum electrodynamics can be transcribed, by means of a stereographic mapping, to the surface of the 5-dimensional unit hypersphere. The resulting formalism is closely related to the Feynman rules, which are also developed, for massless electrodynamics in the conformally covariant O(5,1) language. The hyperspherical formulation has a number of apparent advantages over conventional Feynman rules in Euclidean space: it is manifestly infrared-finite, and it may permit the development of approximation methods based on a semiclassical approximation for angular momenta on the hypersphere. The finite-electron-mass, Minkowski-space generalization of the results gives a simple formulation of electrodynamics in (4,1) de Sitter space. (auth)

15939 FEYNMAN RULES AND FACTOR ORDERING IN DERIVATIVE COUPLING AND SPIN-ONE THEORIES. Kvitky, J. S.; Mouton, J. O. (Univ. of California, Los Angeles). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1693-1707(Nov 1972).

Several methods may be employed to derive the Feynman rules for canonical theories. With emphasis on vector particle theories, the theorem of Lee and Yang is recast into functional integral and Hori operator formulations. For the class of Lagrangians considered, equivalent results are obtained. The canonical generating functional is used to relate T and T* products to the Hamiltonian and Lagrangian versions of theories with dependent fields. With the aid of Hori operators, it is shown that there is a wide class of ordering prescriptions compatible with the Lee–Yang theorem. Of these, the only familiar candidates are normal ordering and symmetrization of momenta and coordinates. It is argued that the latter is preferred, thus confirming a result of Suzuki and Hattori. Finally, the expanded Lee–Yang theorem for general ordering prescriptions is outlined, and ordering for a Yang–Mills theory is discussed. (auth)

15940 QUANTUM SPACE-TIME. Hasebe, K. (Aichi Univ., Toyohashi, Japan). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1742-1750(Nov 1972).

Space-time is quantized so as to obtain a four-dimensional simple cubic lattice. The covariance under Poincaré transformation is guaranteed. The particles interact non-locally. The interaction region is spread so as to form a closed (Euclidean) area in the lattice of space-time. (auth)

15941 HNZ CONSTRUCTION FOR FIXED AND MOVING POLES. POLES. Ezawa, Z. F.; Nishijima, K. (Tokyo Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1751-1753(Nov 1972).

A modified version of the HNZ construction used for constructing the field operator of a particle is given, where particles are classified into moving and fixed poles rather than elementary or composite ones. (LBS)

15942 STRONG LORENTZ CONDITION AND THE SPACE OF STATES IN QUANTUM ELECTRODYNAMICS. Lukierski, J. (Univ., Wroclaw). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 85-89(1968).

It is shown that it is possible to introduce the electromagnetic potentials, satisfying strong Lorentz condition, and manifestly covariant commutation relations. The space of states has indefinite metric. The subsidiary condition, defining physically allowed space of states is introduced. (auth)

15943 $\delta^4(0)$ TERMS IN DIMENSIONAL REGULARIZATION. Capper, D. M.; Leibbrandt, G. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 6: No. 3, 117-118(20 Jan 1973).

It is demonstrated that the 't Hooft-Veltman regularization technique equates the $\delta^4(0)$ terms formally to zero in the interaction Lagrangian for the analytic continuation in the number of space dimensions as a regularization technique in quantum field theory. (JFP)

15944 REMARKS ON MACROSCOPIC CAUSALITY. Rzewuski, J. (Univ., Wroclaw). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 49-55(1969).

An attempt is made to formulate the principle of macroscopic or asymptotic causality in the framework of a functional formulation of S-matrix theory. The postulates of local field theory and equivalence classes are considered. (JFP)

15945 ALGEBRAIC APPROACH TO QUANTUM MECHANICS AND LOCAL QUANTUM FIELD THEORY. Garezynski, W. (Univ., Wroclaw). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 57-71(1969).

The Segal algebraic approach to quantum mechanics and the Haag-Kastler formulation of quantum field theory are reviewed. A relation of the modern formulation of quantum mechanics with the well known formulation in terms of self-adjoint operators in the Hilbert space of states is indicated. (JFP)

15946 NOTE ON SCALE TRANSFORMATIONS. Jadczyk, A. Z. (Univ., Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci., Math., Astron. Phys.; 20: No. 8, 683-687(1972).

Automorphisms of the algebra of quasilocal observables of the free scalar field of zero mass that correspond to scale transformations in $\nu + 1$ space-time dimensions are defined. It is shown that these automorphisms are unitarily implemented in the representations constructed by Streater and Wilde [3] for $\nu = 1$. For $\nu = 3$ a family of vacuum representations is considered, and it is shown that the only vacuum representation that exhibits dilatation symmetry is the Fock one. (auth)

15947 RENORMALIZATION IN INDEFINITE METRIC THEORIES. Hill, C. T. (Massachusetts Inst. of Tech., Cambridge). Int. J. Theor. Phys.; 6: No. 4, 275-280(Oct 1972).

The Lee model, $V \rightleftharpoons N + \theta$ is considered, and a two neutral scalar meson model with indefinite metrics. It is shown that in general the coupling will cause positive definite bare states to become negative length dressed states through renormalization effects. This can render the theory unphysical depending upon the auxiliary conditions imposed with the indefinite metric. (auth)

15948 INFINITE MASS RENORMALIZATION AND THE Z = 0 CONDITION. Tirapegui, E. (Princeton Univ., NJ). Ann. Inst. Henri Poincare, Sect. A; 17: No. 1, 97-109(1972).

The consequences of the condition $\delta \nu^2$ = infinity are examined. The results are compared with those obtained from the Z = 0 condition which have been discussed in a previous work. It is concluded that these two conditions ($\delta \nu^2$ = infinity and Z = 0) are sufficient conditions to have polynomial relations between fields, but neither of them is necessary. It is also argued that the $\delta \nu^2$ = infinity condition is not related to compositeness since it does not permit the elimination of a field from the theory, as is the case with the Z = 0 condition. (France)

15949 PROBLEM OF RELATIVISTICALLY MOVING FRAMES OF REFERENCE. Gutzunayev, Tz. I. Ann. Inst. Henri Poincare, Sect. A; 17: No. 1, 71-79(1972).

A method of deriving relativistic formulas for making transformations to accelerated frames of reference is developed for the case of a one-dimensional motion. Special examples of uniaccelerated frames of reference and oscillating frames are considered. The problem of calculating the electromagnetic field of a uniaccelerated electron is solved by employing a noninertial frame of reference. (France)

15950 GAUGE-INDEPENDENT QUANTIZATION OF THE SCHROEDINGER AND RADIATION FIELDS. Marx, E. (Drexel Univ., Philadelphia). Int. J. Theor. Phys.; 6: No. 4, 307-320 (Oct 1972).

The quantization of several Schrödinger fields interacting with the electromagnetic field is carried out without reference to a particular gauge. The canonical formalism requires a modification introduced by Dirac and Bergmann for constraints. The Coulomb interaction is separated from the radiation and it gives rise to bound states of atoms and molecules. Particle operators are represented in the usual manner in Fock space, while the radiation field can be described by state functionals. Constraints can be included in the canonical formalism by Lagrange multipliers, leading to results equivalent to those of Dirac and Bergmann. (auth)

15951 QUANTIZATION OF NON-LINEAR RELATIVISTIC FIELD WITHOUT RECOURSE TO PERTURBATION THEORY. Rylov, Y. A. (Inst. for Space Research, Moscow). Int. J. Theor. Phys.; 6: No. 3, 181-204(Oct 1972).

A new method of quantization of a nonlinear relativistic field based on separation of the concepts of energy and Hamiltonian is suggested. The proposed method allows the making of the vacuum a stationary state with zero eigenvalues of energy, momentum and charge, and to obtain the exact solutions without recourse to perturbation theory. Infinite integrals, if they appear, turn out to be in the denominator and cause no difficulties. An application of this method is demonstrated by an example of a nontrivial relativistic model. The mass spectrum and S-matrix were obtained. Only exact solutions are used. (auth)

15952 DEVELOPMENT OF THE ASYMPTOTIC ACTION PRINCIPLE. Pugh, R. E. (Univ. of Toronto). Can. J. Phys.; 50: No. 23, 2939-2944(1 Dec 1972).

The action principle for asymptotic quantum field theory is discussed in greater detail. A corollary is derived and an interpolating generator is developed. (auth)

15953 NATURE'S NATURAL NUMBERS. RELATIVISTIC QUANTUM THEORY OVER THE RING OF COMPLEX QUATERNIONS. Edmonds, J. D. (California Western Coll., San Diego). Int. J. Theor. Phys.; 6: No. 3, 205-224(Oct 1972).

The 2×2 complex matrix formulation of relativity and the two-component spin-$\frac{1}{2}$ formalism are merged with the complex quaternion algebra to yield a concise, manifestly covariant formalism of relativistic quantum mechanics. Along with reproducing all the old results of quantum theory, this complex quaternion formulation extends naturally the concept of scalar mass by adding to it orientation- and velocity-dependent parts giving a hypermass. The hyper-mass spin-$\frac{1}{2}$ equation, with the scalar part of the mass set equal to zero, gives a subtle variation on the two-component neutrino theory with very unsubtle consequences, such as an invariant mass parameter which could distinguish ν_e and ν_μ and elimination of the superposition principle. (auth)

Gravitation and General Relativity

Refer also to abstract 15612.

15954 (ITF-72-117-P) GLOBAL STRUCTURE OF THE HIGHLY MOBILE EINSTEIN SPACE OF PETROV TYPE T_3*. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only).

It is shown that the highly mobile Einstein space of type T_3^* can be of the following topological types: R^4, R^3T^1, R^2T^2, R_1T^3, ($R^\alpha T^\beta$ is a topological product of α straight lines and β circles). (auth)

15955 (ITF-72-139-P) TOTAL MODELLING OF GRAVITATIONAL FIELDS INTO A PLANE SPACE WITH SYMMETRY CONSERVATION. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 32p. (In Russian). Dep. NTIS (U. S. Sales Only).

The idea of symmetry conservation under modelling amplifies A. Z. Petrov's idea of gravitational field modelling. The modelling of general gravitational fields and Einstein spaces into a plane space with symmetry conservation is considered in detail. (auth)

15956 (ITF-72-140-P) GLOBAL INVESTIGATION OF THE EINSTEIN SPACE OF MAXIMAL MOBILITY AND PETROV TYPE II. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The space V of Petrov type II ($\chi \neq 0$) of maximal mobility and acting in the motion group G is investigated. G is homeomorphic to the Euclidean space R^5. V is a homogeneous space of left cosets of G and is homeomorphic to the Euclidean space R^4. (auth)

15957 NONLOCAL LINEAR GRAVITATION THEORY. Hafner, H. (Inst. of Atomic Physics, Bucharest). Stud. Cercet. Fiz.; 24: No. 5, 593-626(1972). (In Rumanian).

The discussion of nonlocal linear gravitation theory covers the field equation, Deser and Schwarzschild line element, and the field equation in the case of the local theory. (JFP)

15958 GENERAL RELATIVITY IN THE EQUAL PROPER TIME FORMALISM. Cook, J. L. (Australian Atomic Energy Commission, Sutherland). Aust. J. Phys.; 25: No. 5, 469-77 (Oct 1972).

The general theory of relativity is discussed within the framework of the concept of surfaces of equal proper time as outlined previously. The three main tests of general relativity, namely the precession of the perihelion of mercury, the gravitational shift of spectral lines, and the gravitational deflection of light rays by massive sources, are considered, and it is shown that, though the modified equations are Lorentz-invariant with respect to distant observers, the deviations from conventional results are so minute as to be undetectable. (auth)

15959 GRAVITATIONAL FIELD OF A CHARGED MASS POINT IN THE SCALAR-TENSOR THEORY. Luke, S. K.; Szamosi, G. (Univ. of Windsor, Ont.). Phys. Rev., D; 6: No. 12, 3359-3363(15 Dec 1972).

The gravitational field of a static, electrically charged mass point is obtained exactly in the framework of the scalar-tensor theory. It is the counterpart of the Nordström–Reissner solution in the Einstein theory. (auth)

15960 GENERALIZATION OF THE EINSTEIN THEORY. Rastall, P. (Univ. of British Columbia, Vancouver). Phys. Rev., D; 6: No. 12, 3357-3359(15 Dec 1972).

The assumption that $T^{\nu}_{\mu\nu} = 0$ in curved space-time is questioned. Field equations are given which are consistent with the assumption $T^{\nu}_{\mu;\nu} = \lambda R_{\mu}$, and which reduce to the Einstein equations when $\lambda = 0$. The equations are equivalent to the Einstein equations in empty space-time, but differ from them in the presence of matter. Applications to cosmology, stellar structure, and collapsing objects are suggested. (auth)

15961 CAN GRAVITATION HAVE A FINITE RANGE? Boulware, D. G. (Univ. of Washington, Seattle); Deser, S. Phys. Rev., D; 6: No. 12, 3368-3382(15 Dec 1972).

No acceptable tensor gravitational theory with arbitrarily long but finite range exists. In linear approximation, the infinite-range limit is a scalar-tensor mixture implying an effective matter–matter coupling different from the strictly infinite-range prediction and contradicted by experiment. Compensation of the scalar requires the admixture of a ghost scalar coupling. In the massive version of the full Einstein theory, (a) there are necessarily six rather than the five tensor degrees of freedom, (b) the energy has no lower bound, (c) the infinite-range limit seems not to exist at all, and (d) lowest-order forces are the same as in the massive linearized theory. (auth)

15962 ROTATING SPHERE AS A POSSIBLE SOURCE OF THE KERR METRIC. Florides, P. S. (Trinity Coll., Dublin). Nuovo Cim.; 13B: No. 1, 1-18(11 Jan 1973).

The gravitational field of a sphere rotating steadily about one of its diameters is calculated, inside and outside the sphere, up to the order k^5 using the Florides–Synge method of successive approximations: $k \sim (m/b)^{\frac{1}{2}}$, where m is the mass and b the radius of the sphere. Under the assumption that the constants m and a appearing in the Kerr (exterior) metric are of order k^2 and k, respectively, it is shown that the Kerr metric, up to the order k^5, is precisely the (exterior) field of a rotating sphere to the same order. Since in the Florides–Synge method the field is calculated simultaneously inside and outside the sphere, the Kerr exterior metric is automatically extended to an interior metric up to the order k^5. (auth)

15963 TACHYONS IN A GRAVITATIONAL FIELD. Hettel, R. O.; Helliwell, T. M. (Harvey Mudd Coll., Claremont, CA). Nuovo Cim.; 13B: No. 1, 82-90(11 Jan 1973).

Equations of motion are derived for tachyons moving in the spherically symmetric Schwarzschild geometry. The equations are solved for small deflections of tachyon paths by a mass like the sun; it is found that infinite-velocity tachyon paths bend half as much as photon paths. The radii of (unstable) circular orbits are also computed. In each case it is shown that tachyon paths form a natural extension of the well known tardyon and photon paths. (auth)

15964 MACROSCOPIC HIGH-FREQUENCY QUANTUM GENERATOR AND DETECTOR OF GRAVITATIONAL RADIATION. Kopvillem, U. H.; Nagibarov, V. R.; Samartsev, V. V. (Physical-Technical Inst., Kazan, USSR). Phys. Lett.; 42A: No. 6, 399-400 (15 Jan 1973).

The scheme of a generator and detector of coherent gravitational radiation is investigated, when the energy transitions in two, three etc. particles simultaneously are considered. (auth)

15965 PROPAGATION OF THE DISCONTINUITIES OF THE COVARIANT DERIVATIVE OF THE ELECTROMAGNETIC FIELD AND THE CURVATURE TENSOR IN AN ELECTROMAGNETIC AND GRAVITATIONAL WAVE. Gal, P.-Y. Ann. Inst. Henri Poincare, Sect. A; 17: No. 1, 59-70(1972). (In French).

In the space-time of the general theory of relativity in vacuum, a wave may be both electromagnetic and gravitational, i.e., a hypersurface S across which both the covariant derivative of the electromagnetic field and the curvature tensor are discontinuous. Equations of propagation along S for these tensor discontinuities are established. (France)

15966 SIMPLIFICATION OF THE CONSTRAINTS IN THE DIRAC FORMALISM FOR GENERAL RELATIVITY. Klotz, F. S. (Univ. of Syracuse, NY). Int. J. Theor. Phys.; 6: No. 4, 251-257(Oct 1972).

In any classical theory in canonical form, the Poisson bracket relations between the constraints are preserved under canonical transformations. It is shown that in the Dirac formalism for general relativity this condition places certain limits on the degree to which one can simplify the form of the constraints. It implies, for instance, that the constraints cannot all be written as canonical momenta. Furthermore, it is not even possible to reduce them all to purely algebraic functions of the momenta by means of a canonical transformation which preserves the original configuration space subspace of phase space. (auth)

15967 MOTION OF PHOTONS IN A STRONG GRAVITATIONAL FIELD IN THE NEIGHBORHOOD OF A SUPERDENSE STAR. Sutantyo, W. Proc., Inst. Teknol. Bandung; 6: No. 2, 57-63(1971). (In Indonesian).

A review of the motion of photons in a strong gravitational field is given. Photons which are emitted from the neighborhood or from within a superdense star, may escape, falling or moving in a circular orbit, depending on the initial direction of the photons. (auth)

Scattering Theory

Refer also to abstracts 15895 and 16240.

15968 (DESY-72/59) MULTI-REGGE-EXCHANGE AND EIKONALIZATION. Bartels, Jochen (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Oct 1972. 38p. Dep. NTIS (U. S. Sales Only).

The Regge-eikonal model in ϕ^3-theory is studied within the framework of the impact-picture of Cheng and Wu or, equivalently, the reggeon calculus of Gribov. The exchanged reggeons are Bethe–Salpeter amplitudes in the ladder approximation and thus contain all orders of the coupling constant in the vertex function and trajectory function. This gives a more detailed insight into eikonalization than earlier studies, where the exchanged ladders were taken only in the weak-coupling limit. It is found in contrast to earlier studies—that not all permutations of the reggeon legs to the external particles are equally important, but a certain subgroup of them dominates. Furthermore, it is seen that the situation of eikonalization in the weak-coupling limit of the ladders is quite different from the more general case, where vertex- and trajectory-functions contain all orders of the coupling-constant. (auth)

15969 (ITF-72-124-P) SOME PROPERTIES OF THE DOUBLE SPECTRAL FUNCTION OF DAMA. Bugrii, A. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The behavior of a dual amplitude with Mandelstam analyticity in the region of the double spectral function is studied. It is shown that amplitude satisfies the Mandelstam representation with finite number of subtractions if the Regge trajectory is restricted by conditions Re $\alpha(s) \leq$ const for $S \to \infty$. The double spectral function assumes its largest values in the strips along its boundary. (auth)

15970 (ITF-72-128-P) INITIAL CONDITIONS IN NON-HAMILTONIAN DYNAMICS. Zhdanov, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

The proof is given of the Driver's theorem concerning existence and uniqueness of the "inverted" solutions in the two-body problem for the neutral type equations. The case when the solutions of the equations for retardation do not exist is specially considered. Similar proof takes place when the equations contain advancing potentials. The classical limit for the solutions with initial data given on the finite segment is considered. (auth)

15971 REAL PART OF THE (NONPOMERON) REGGE AMPLITUDE AND THE DUAL ABSORPTIVE MODEL. Minami, S. (Osaka City Univ.). Lett. Nuovo Cim.; 5: No. 18, 1113-16(30 Dec 1972).

The properties of the real parts of the helicity nonflip and flip amplitudes are examined by studying the relation between the imaginary and real parts of the amplitude in the dual absorptive model. The interaction range responsible for the real part of the helicity amplitude is discussed. It is shown that the real part of the amplitude is dominated by either the peripheral partial waves or the $l \sim kr'$ waves, where k is the center-of-mass momentum and $r'_- \simeq 0.58 \times 10^{-13}$ cm. (LBS)

15972 CONNECTED-KERNEL HEITLER EQUATIONS. Kowalski, K. L. (Case Western Reserve Univ., Cleveland). Phys. Rev., D; 6: No. 12, 3705-3708(15 Dec 1972).

The Heitler-type equations relating the three-particle transition and K matrices are replaced by equivalent connected-kernel equations. This constitutes the practical realization of the K-matrix formalism for the usual class of three-particle nonrelativistic scattering problems. (auth)

15973 HIGH-ENERGY APPROXIMATIONS IN A POTENTIAL MODEL. Chavda, L. K. (Univ. of Alberta, Edmonton). Phys. Rev., D; 6: No. 12, 3696-3700(15 Dec 1972).

Some recently proposed models of high-energy scattering are studied in the infinite-range limit of the Yukawa potential. Comparison is made with the Glauber and Blankenbecler–Goldberger models. (auth)

15974 SECOND-ORDER EIKONAL APPROXIMATION FOR SCATTERING. Baker, Adolph (Lowell Tech. Inst., MA). Phys. Rev., D; 6: No. 12, 3462-3469(15 Dec 1972).

An eikonal approximation for potential scattering at high energies is derived to second order in 1/k for the Schrödinger equation. The procedure is based on the same assumptions and restrictions introduced by Glauber, except that the derivation is carried one order further. Whereas Glauber's solution provides for phase modulation of the incoming plane wave, the second-order eikonal approximation, in addition to amending the phase term, turns out also to include an amplitude modulation factor. This approximation, which is the result of maintaining the original calculation to higher order, differs in general from the perturbation correction by Wallace of Glauber's first-order eikonal approximation, although both reduce to the same correct solution for the special case of Coulomb scattering. (auth)

15975 MULTI-REGGE EXPRESSION FOR THE 3-TO-3 AMPLITUDE. Patrascioiu, A. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., D; 6: No. 12, 3516-3522(15 Dec 1972).

Previous work regarding singularities in complex helicity is continued and certain points raised by other authors are clarified. The helicity-pole–Regge-pole asymptotic expression must be complicated in order to contain all particle poles in the 3-to-3 amplitude. A method of "tree expansions" is introduced incorporating these complications in the scheme of crossed partial-wave analysis. (auth)

15976 TWO-VARIABLE EXPANSIONS FOR THREE-BODY DECAYS INVOLVING PARTICLES WITH ARBITRARY SPINS. Shukre, V.; Winternitz, P. (Univ. of Pittsburgh). Phys. Rev., D; 6: No. 12, 3607-3617(15 Dec 1972).

Helicity amplitudes for the decay process $1 \to 2 + 3 + 4$ involving particles with arbitrary spins are expanded in terms of matrix elements of the O(4) group transformations. The resulting expansions display the entire dependence on the kinematic parameters (energies and angles) explicitly and can be interpreted as standard O(3) partial-wave expansions of the amplitudes in a center-of-mass-like frame of reference, supplemented by O(4) expansions of the partial-wave helicity amplitudes. Restrictions on the O(4) amplitudes due to parity conservation are established, the physical meaning of all the quantum numbers figuring in the expansion is clarified, and the expansions are shown to have a reasonable threshold and pseudothreshold behavior. The expansion formula, as well as its inverse, involves amplitudes defined in the physical decay region only. The O(4) expansions of this paper are a modification of O(3,1) expansions of helicity amplitudes for the scattering of particles with arbitrary spins, suggested in the preceding paper. For spinless particles the corresponding expansions have been derived and applied earlier by Hicks and Winternitz. (auth)

15977 EIKONAL CANCELLATIONS IN A SOLVABLE MODEL. Fried, H. M. (Brown Univ., Providence). Phys. Rev., D; 6: No. 12, 3562-3568(15 Dec 1972).

Two versions of a high-energy field-theoretic eikonal amplitude are examined in a special limit of large internal mass, where infinite sums over all n-point, connected, eikonal graphs become calculable. Both examples exhibit cancellations which tend to reduce the energy dependence of σ_T below the Froissart bound. (auth)

15978 TWO-VARIABLE LORENTZ-GROUP EXPANSIONS OF PHYSICAL SCATTERING AMPLITUDES FOR PARTICLES WITH ARBITRARY SPINS. Shukre, C.; Winternitz, P. (Univ. of Pittsburgh). Phys. Rev., D; 6: No. 12, 3592-3606(15 Dec 1972).

Two-variable expansions of relativistic scattering amplitudes that have previously been suggested for the scattering and decays of spinless particles are generalized to the case of two-body scattering of particles with arbitrary spins. The usual helicity amplitudes are expanded in terms of the transformation matrices of the homogeneous Lorentz group in a basis, corresponding to the group reduction $O(3,1) \supset O(3) \supset O(2)$. The expansion can be interpreted as the usual Jacob and Wick partial-wave expansion, in which the energy dependence of the partial-wave helicity amplitudes is further expanded in terms of the O(3,1) d functions. Restrictions due to parity and time-reversal invariance are discussed. The O(3,1) expansions are shown to have the correct threshold behavior "term by term". Further generalizations of the formalism to include O(2,1) expansions (and thus Regge-pole theory) are discussed as well as applications to particle decays (these will be presented separately). (auth)

15979 POSITIVITY, SUBTRACTIONS, AND THE MODULI OF SCATTERING AMPLITUDES. Creutz, M. (Univ. of Maryland, College Park). Phys. Rev., D; 6: No. 12, 3533-3537(15 Dec 1972).

It is shown that if an amplitude has certain positivity properties as would be given by an optical theorem and if it obeys a dispersion relation with a known number of subtractions, then the amplitude can be uniquely and explicitly found from its modulus on the cuts and a known number of additional parameters. Applying this result to forward polarized Compton scattering, it is found that the necessary additional parameters are fixed by low-energy theorems in terms of the static electromagnetic properties of the target. (auth)

15980 HAAG'S THEOREM IN THE SCATTERING THEORY AND ITS GENERALIZATION. Garczynski, W. (Univ., Wroclaw). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 111-115(1968).

A review is given of the formulation of the Haag theorem. A generalized version of the theorem is given. Various known formulations of Haag's ideas underlying this theorem in different contexts are classified, and some of the mathematical problems are pointed out. It is found that the most natural domain of application of Haag's ideas is offered by scattering theory formulated within the axiomatic approach to quantum field theory. (JFP)

15981 POTENTIAL IN HIGH-ENERGY PHYSICS. Chylinski, Z. (Inst. of Nuclear Research, Krakow). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 39-50(1968).

The generalization of the nonrelativistic (NR) Schroedinger equation is proposed on the basis of directly unobservable coordinates $(\tau, \vec{y})$. They are the generalization of the NR relative coordinates and the absolute Newtonian time. These variables are introduced together with an isolated system, and they enable one to generalize the NR potentials. Within this framework one is in a position to describe the high energy resonance-states (particles) in full analogy to the low energy resonances and energy levels described so successfully by the NR Schroedinger equation. (auth)

15982 KINEMATICAL SINGULARITIES OF THE SCATTERING AMPLITUDES. Kotanski, A. (Jagellonian Univ., Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 73-78 (1969).

Some investigations of the kinematical singularities of helicity amplitudes are reviewed. The amplitudes in which the spins are projected on the beam direction are discussed, and it is argued that they have simpler kinematical singularities than the helicity amplitudes. (JFP)

15983 DIAGRAM TECHNIQUES AND CLASSIFICATION PROBLEMS IN HIGH ENERGY PHYSICS. Cunningham, J. (University Coll. of North Wales, Bangor). Nucleus (Karachi); 9: No. 1-2, 71-4(1972).

The mathematical structure of collision amplitudes in perturbative field theory is discussed, and the roles of graph theory and algebraic geometry in the classification of the associated Feynman diagrams are described. The use of elementary topological ideas to classify the Feynman-like diagrams of dual resonance models is indicated. (auth)

PHYSICS (LOW-TEMPERATURE)

Superfluidity

15984 (ITF-72-135-P) INVESTIGATION OF THE INTERACTING BOSON SYSTEMS WITH THE HELP OF THE DISPLACEMENTS AND COLLECTIVE VARIABLES METHOD. Yukhnovskii, I. R.; Vakarchuk, I. A. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 35p. (In Russian). Dep. NTIS (U. S. Sales Only).

The variables that describe ground and excited states in the Schroedinger equation of interacting Bose system are "separated" with the help of transformation of displacement. The separation of variables corresponds to the two-fluid description of superfluidity of liquid helium He^4. Due to the symmetry of the wave function one can use the collective variables as the variables describing the system. That enables us to find solutions of the received equations for the logarithm of the wave function of the ground state and for the wave functions of the excited states in the form of series with respect to collective variables and to formulate a special method to get the solution without divergency. The expressions for the wave functions, energy of the ground state, energy spectrum and attenuation of collective excitations were investigated for the certain models. (auth)

15985 ZERO-MOMENTUM CONDENSATE FRACTION IN GROUND-STATE HELIUM. Fernandez, J. F.; Gersch, H. A. (Georgia Inst. of Tech., Atlanta). Phys. Rev., A; 7: No. 1, 239-242(Jan 1973).

Estimates are given for the zero-momentum condensate fraction of ground-state ^{4}He described by a Jastrow wave function at the solidification density of the fluid (2%) and at the melting density of the solid (~1%). Indications are given that these estimates may be sensitively dependent on the form of the pair function utilized. (auth)

15986 PVT SURFACE OF He^4 NEAR ITS CRITICAL POINT. Kierstead, H. A. (Argonne National Lab., IL). Phys. Rev., A; 7: No. 1, 242-251(Jan 1973).

High-resolution measurements of the pressure coefficient $(\partial P/\partial T)_\rho$ of ^{4}He are reported in both the one-phase and two-phase regions close to the critical point. The data consist of 29 isochores covering the density range $-0.2 < \Delta\rho < 0.2$ and the temperature range $-0.020 < t < 0.032$, where $\Delta\rho = (\rho - \rho_c)/\rho_c$ and $t = (T - T_c)/T_c$. The intersections of the isochores with the coexistence curve locate 28 points on the coexistence curve. These points fit the equation $|\Delta\rho| = (1.395 \pm 0.020)t^\beta$, with $\beta = 0.3554 \pm 0.0028$ and $\rho_c = 69.580 \pm 0.020$ mg/cm^3. Parameters are reported for the best fit of the data to the "linear model" of Schofield, Litster, and Ho, in which the critical exponents have the values $\alpha = 0.115 \pm 0.006$ and $\gamma = 1.1743 \pm 0.0005$, and to a more accurate parametric model in which $\alpha = 0.067 \pm 0.006$ and $\gamma = 1.2223 \pm 0.0017$. The more accurate model does not have the symmetry required by the scaling hypothesis. (auth)

15987 LUMINESCENCE OF HELIUM II PRODUCED BY WEAK α-PARTICLE SOURCES. Roberts, H. A.; Hereford, F. L. (Univ. of Virginia, Charlottesville). Phys. Rev., A; 7: No. 1, 284-91 (Jan 1973).

Measurements of the intensity of luminescence produced by weak α-particle sources in He II are presented for $0.3 < T < 4.2$°K, for different chamber sizes, and with an electric field applied in the region of the α-particle source. With zero field the intensity exhibits a complex behavior, remaining approximately constant between T_λ and 1.2°K, then dropping to a minimum near 0.6°K, and rising again at lower temperatures. The application of an electric field (up to 13,000 V/cm) in the source region reduces the intensity above 0.8°K but increases it at lower temperatures. The transient behavior of the luminescence upon application of a pulsed field is described and discussed. The qualitative features of the temperature dependence of the luminescence are accounted for in terms of radiation from metastable systems, the diffusion coefficient of which rises exponentially ($\sim e^{\Delta/kT}$) as the temperature drops. Approximate values of the diffusion coefficient are presented. The electric-field-induced amplification of the luminescence below 0.8°K is attributed to metastable interactions with charged vorticity. (auth)

15988 LIQUID STRUCTURE FUNCTION FOR DILUTE He^3–He^4 SOLUTIONS. Tan, H. T. (Univ. Malaya, Kuala Lumpur, Malaysia); Woo, C. W. Phys. Rev., A; 7: No. 1, 233-239 (Jan 1973).

Semitheoretical estimates are presented for the liquid structure function $S_k(x)$ of ^{3}He–^{4}He solutions at low-^{3}He concentrations x. The calculation makes use of a perturbation theory in the representation of correlated basis functions, a variational procedure for intermediate- and high-momentum transfers, experimental data on the concentration dependence of the velocity of sound, and an interpolation between $k \approx 0.6$ and 1.2 Å^{-1}. For a 6% solution, the entire $S_k(0.06)$ curve is obtained. Experimental measurements, presumably by x-ray scattering, are not yet available. (auth)

15989 PHENOMENOLOGICAL HAMILTONIAN IN THE THEORY OF SUPERFLUID ^{4}He. Eckstein, S. G.; Friedlaender, D. R.; Kuper, C. G. (Technion-Israel Inst. of Tech., Haifa). Phys. Rev. Lett.; 30: No. 3, 78-81(15 Jan 1973).

It is shown that a many-body Hamiltonian, expressed in terms of renormalized quasi-particle operators, has interactions only on the energy shell. The result justifies the method of Havlin and Luban, who resolve the discrepancy between the theoretical and experimental velocity of sound in ^{4}He. It also follows that the phonon spectrum must be concave at low momenta. (auth)

15990 SPECIFIC HEAT OF LIQUID He^3/He^4 MIXTURES NEAR THE JUNCTION OF THE λ AND PHASE-SEPARATION CURVES. II. Islander, S. T. (Technical Univ. of Helsinki, Otaniemi, Finland); Zimmermann, W. Jr. Phys. Rev., A; 7: No. 1, 188-197 (Jan 1973).

Measurements of the molar specific heat $c_{P,x}$ of liquid ^{3}He/^{4}He mixtures at saturated vapor pressure near the junction of the λ and phase-separation curves reported in an earlier paper were used to calculate values of $(\partial s/\partial T)_{P,x} = c_{P,x}/T$, $(\partial\phi/\partial T)_{P,x} = -(\partial s/\partial x)_{P,T}$, s, and $\phi - \phi_0$ at saturated vapor pressure throughout the junction region. Here ϕ is the difference $\mu_3 - \mu_4$ between molar chemical potentials, x is the mole fraction of ^{3}He present, and the subscript 0 denotes the value of a quantity at the junction. Comparisons of $(\partial s/\partial T)_{P,x}$ and $(\partial\phi/\partial T)_{P,x}$ with their respective upper bounds at the λ curve $(ds/dT)_{P,\lambda} + (d\phi/dT)_{P,\lambda}(dx/dT)_{P,\lambda}$ and $(d\phi/dT)_{P,\lambda}$ suggest but do not require that $(\partial s/\partial T)_{P,\phi} = c_{P,\phi}/T$ diverge all along the λ curve, as the results indicate that it does at the junction. The results are consistent with the following asymptotic behaviors at the junction: $(\partial s/\partial T)_{P,x,0} - (\partial s/\partial T)_{P,x} \sim (T - T_0)^1$ at $x = x_0$ for $T > T_0$; $|\phi - \phi_0| \sim |x - x_0|^2$ at $T = T_0$ for $x \lesssim x_0$; $(\partial s/\partial T)_{P,\phi} \sim |T - T_0|^{-\frac{1}{2}}$ at $\phi = \phi_0$ for $T \lesssim T_0$. (auth)

15991 MEAN-FIELD THEORY FOR INTERACTING ROTONS IN SUPERFLUID HELIUM. Jaeckle, J. (Univ., Geneva). Z. Phys.; 257: No. 1, 14-21(1972).

It is shown within the framework of mean-field theory that the gas of roton excitations in superfluid helium becomes unstable at a critical temperature T_c if the roton–roton interaction is attractive. The instability is characterized by a singularity of the specific heat and signals the transition into the normal fluid state. The roton energy gap remains finite at T_c. (auth)

Superconductivity

Refer also to abstract 16482.

15992 RELATION BETWEEN THE APPLIED MAGNETIC FIELD VS CRITICAL CURRENT DENSITY CHARACTERISTICS AND THE MICROSTRUCTURES FOR SUPERCONDUCTING Nb–Ti–Zr SHEETS. Kitada, Masahiro (Hitachi Ltd., Kokubunji, Japan). J. Jap. Inst. Metals; 36: No. 11, 1064-9(Nov 1972). (In Japanese).

The microstructures of Nb–Ti–Zr sheets were investigated to make clear the relation between the microstructures and the applied magnetic field vs critical current density characteristics. The results are summarized as follows: (1) The ratio of $J_c(\|)/J_c(\perp)$ are in proportion as the ratio of $(a + d)/a$, where $J_c(\|)$ and $J_c(\perp)$ are the critical current densities measured with applied magnetic fields parallel to the rolling plane and perpendicular to the rolling plane, respectively; a and d are the thickness for the "defect layer" and for the "defectless layer", respectively, in the cross section of the specimen. (2) $J_c(\|)$ increases with the increasing tensile strength in the aging treatment. (3) $J_c(\|)$ and $J_c(\perp)$ increase with increasing deformation. The dependence of $J_c(\|)/J_c(\perp)$ on the degree of deformation (ϵ) can be expressed by an empirical formula, $J_c(\|)/J_c(\perp) \propto 0.012 \times \epsilon$. The relations among the peak effect, the texture, and the microstructures are also discussed. (auth)

15993 ANDERSON HAMILTONIAN AND THE EFFECT OF d AND f LOCALIZED STATES ON SUPERCONDUCTIVITY.

Ratto, C. F. (Univ., Genoa). Riv. Nuovo Cim.; 2: No. 3, 303-24(1972).

An attempt is made to show that it is the presence of resonant states, and their internal structure, which mainly determine the superconducting critical temperature and other properties of these systems. It is briefly shown how the Anderson Hamiltonian, which describes the resonant states, can be treated in order to study the superconducting state both in alloys and in pure rare-earth metals. The experimental situation is reviewed; alloys containing transition-metal impurities, rare-earth impurities, and uranium impurities are considered as well as pure lanthanum and pure cerium. Theory and experiments are compared. (71 references) (MHR)

15994 CRITICAL CURRENTS AND MAGNETIZATION OF SUPERCONDUCTING ALLOYS. Bychkov, Yu. F.; Vasil'ev, N. G.; Vereshchagin, V. G.; (and others) (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 6, 2187-97 (Dec 1972). (In Russian).

The dependence of the transverse critical current on external magnetic field strength ($j \perp H$) and temperature of Zr–Nb alloys is investigated in the $0 < H < H_{c2}$ region. The results obtained are interpreted on basis of information regarding the structural state of the alloys and by applying the model of a rigidly fixed vortex lattice in which the proximity effect is taken into account. The complete cycle of the magnetization hysteresis curve is described analytically by applying the Bean critical state concept to a superconducting alloy with a rigidly fixed fluxoid system, the dependence of critical current on external magnetic field being exponential. Satisfactory agreement between the experimental dependence M(H) and the theoretical calculations is demonstrated for model Zr–20% Nb and Zr–35% Nb alloys at magnetic field strengths ranging from 0 to 0.5 H_{c2}. (auth)

15995 INVESTIGATION OF DISSIPATIVE PROCESSES IN SINGLE CRYSTAL SUPERCONDUCTORS OF THE II KIND. Chigvinadze, Dzh. G. (Inst. of Physics, Tbilisi, USSR). Zh. Eksp. Teor. Fiz.; 63: No. 6, 2144-50(Dec 1972). (In Russian).

Dissipative processes are investigated by means of a special nonconduction technique in single-crystal samples of the Type-II superconductor $Ta_{70}Nb_{30}$. (auth)

15996 SUPERCONDUCTIVITY IN THE PALLADIUM–HYDROGEN AND THE PALLADIUM–DEUTERIUM SYSTEMS. Stritzker, B.; Buckel, W. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 257: No. 1, 1-8(1972).

Superconducting transitions were observed in the Pd–H and Pd–D systems up to temperatures of 9 and 11°K, respectively. The high concentrations necessary for superconducting were obtained by implanting H or D ions into the Pd at liquid-helium temperatures. (auth)

15997 SUPERCONDUCTIVITY IN AMORPHOUS TRANSITION-METAL ALLOY FILMS. Collver, M. M.; Hammond, R. H. (Univ. of California, Berkeley). Phys. Rev. Lett.; 30: No. 3, 92-5(15 Jan 1973).

The superconducting transition temperatures of "amorphous" transition-metal alloys were measured. The variation of T_c as a function of the electron-to-atom ratio is consistent with the presence of an atomic-like parameter characterizing the systematics of T_c, with, however, an unexplained peak at the half-filled d shell. The data do not support a recent explanation based entirely on a simple averaging or smearing of the crystalline electronic density of states. (auth)

15998 FARADAY INDUCTION AND FLUX FLOW VOLTAGES IN TYPE-II SUPERCONDUCTORS. Khanna, S. M.; LeBlanc, M. A. R. (Univ. of Ottawa). J. Appl. Phys.; 43: No. 12, 5165-74(Dec 1972).

The integrated voltages $S \propto \int V(t)dt$ observed across an open single-layer superconducting coil, when a magnetic flux $\Delta\phi$ trapped in the body of the coil winding is expelled, are not uniquely described by the classical Faraday induction relation $\int V(t)dt \propto \Delta\phi$ but depend dramatically on the procedure used for thermally destroying the superconducting state. The observed signals are larger (smaller) than S_s when the trapped flux is eliminated by heating the sample from the inside (outside), where S_s is the result encountered upon quenching of the trapped flux by slow heating of the sample equally and simultaneously from the inside and outside. Normalizing the measured signals to S_s, it is found that limiting values of 3.15 and −1.05 are attained depending on whether the heating pulse which causes the trapped flux to be expelled is applied to the inner or the outer surface, respectively. Noting the contribution to the measurements arising from the collapse of the flux returning through the space embraced by the sample coil, all the observations are accounted for on the basis that (i) the migration of flux filaments across the wall of the sample produces no effect externally detected by the voltmeter and (ii) the collapse of a vortex at the inner surface of the sample coil induces a signal proportional to ϕ_0, the flux enclosed by the vortex, whereas a vortex collapsing at the outer surface induces no signal. These measurements indicate that the observed voltages due to flux flow in a superconductor are produced by the change of magnetic flux embraced by the measuring circuit excluding the volume of the superconducting element. (auth)

15999 MAGNETIC-FIELD-INDUCED ONE-DIMENSIONAL BEHAVIOR IN THE SPECIFIC-HEAT TRANSITION IN DIRTY BULK SUPERCONDUCTORS. Hassing, R. F. (Indiana Univ., Bloomington); Hake, R. R.; Barnes, L. J. Phys. Rev. Lett.; 30: No. 1, 6-9(1 Jan 1973).

The specific heat is calculated in the transition region for an extreme type-II bulk superconductor [zero-temperature Ginzburg–Landau (GL) coherence length $\xi(0) \approx 48$ Å, dirtiness parameter $\xi_0/l \approx 120$, GL parameter $\kappa \approx 67$] for various values of applied magnetic field H, and compared with previously published data. Nonlocality is neglected and the quartic term in the GL free-energy functional is treated in a Hartree approximation. The calculated and measured transitions broaden with increasing H, the latter in a manner suggestive of an approach to the theoretically predicted one-dimensional form. (auth)

16000 SUPERCONDUCTING PROPERTIES OF CRYSTALLINE ULTRATHIN FILMS. Strongin, M.; Kammerer, O. F.; Farrell, H. H. (Brookhaven National Lab., Upton, NY). Phys. Rev. Lett.; 30: No. 4, 129-32(22 Jan 1973).

Measurements are presented of the superconducting transition temperature of ultrathin aluminum films grown epitaxially on silicon. The transition temperature is found to be near the bulk T_c and is significantly lower than that found in disordered films. Some initial experiments on growing epitaxial Pb films on PbTe are also discussed. (auth)

16001 ANISOTROPY OF THE CRITICAL DATA OF SUPERCONDUCTING V_3Si SINGLE CRYSTALS. Pulver, M. (Univ., Giessen, Ger.). Z. Phys.; 257: No. 1, 22-8(1972).

The critical magnetic field and the critical currents in transverse magnetic fields are measured for V_3Si-single crystals with the current flowing along the [100]- and the [110]-directions of the crystal. A strong anisotropy is found for the critical current. An explanation of this behavior may be connected with the anisotropy of the energy gap. (auth)

16002 FLUCTUATIONS IN COUPLED SUPERCONDUCTING GRAINS. Deutscher, G.; Imry, Y. (Tel-Aviv Univ., Israel). Phys. Lett.; 42A: No. 6, 413-414(15 Jan 1973).

The fluctuations of the order parameter for a system of coupled grains are calculated in the Gaussian approximation. Estimates for the critical region are obtained. (auth)

16003 DIRECT OBSERVATION OF GROWTH OF THE LANDAU DOMAIN STRUCTURE. Farrell, D. E.; Huebener, R. P.; Kampwirth, R. T. (Case Western Reserve Univ., Cleveland). Solid State Commun.; 11: No. 12, 1647-1649(15 Dec 1972).

The growth process of the Landau domain structure has been directly observed for the first time, in superconducting lead. These observations have resulted in a simple experimental procedure for growing more regular examples of that structure than previously obtained. (auth)

16004 CRITICAL CURRENTS AND PINNING EFFECT IN SUPERCONDUCTING ALLOY FILMS SPATIALLY MODULATED IN CONCENTRATION. Raffy, H.; Renard, J. C.; Guyon, E. (Compagnie Generale d'Electricite, Marcoussis, France). Solid State Commun.; 11: No. 12, 1679-1682(15 Dec 1972).

Some preliminary results are presented of an experimental study of pinning effects in superconducting inhomogeneous Pb–Bi films. The Bi concentration is modulated periodically in the direction perpendicular to the film plane, with a period of the order of magnitude of the superconducting characteristic lengths. The critical current density of these films, $J_c(H)$, in a field H parallel to the film plane and perpendicular to J, is markedly increased compared to the critical current density of homogeneous or completely diffused films. In addition, the $J_c(H)$ curves show a peak structure characteristic of the period of the spatial modulation. (auth)

16005 EFFECT OF FLUCTUATIONS ON THE MAGNETIZATION OF DIRTY SUPERCONDUCTORS. Usadel, K. D. (Cornell Univ., Ithaca, NY). Solid State Commun.; 11: No. 12, 1699-1702 (15 Dec 1972).

The standard expression for the fluctuation contribution to

the free energy is modified in a way consistent with the electron–phonon model of superconductivity. Using this modification, the magnetization is calculated in the dirty limit at T_c. (auth)

16006 TRANSITION-METAL IMPURITIES IN A SUPERCONDUCTOR. Shiba, H. (Osaka Univ.). Solid State Commun.; 11: No. 12, 1735-1739(15 Dec 1972).

Superconducting dilute alloys containing transition metal impurities are studied within the Hartree–Fock approximation. Localized excited states in the energy gap, the decrease of the transition temperature and the change of the jump of the specific heat due to impurities are discussed. (auth)

16007 APPARENT RESISTANCE OF NON-IDEAL TYPE II SUPERCONDUCTORS. Zenkevitch, V. B.; Andrianov, V. V.; Kurguzov, V. V.; Sytchev, V. V.; Ternovskii, F. F. (Inst. of High Temperature, Moscow). Cryogenics; 12: No. 6, 427-437 (Dec 1972).

The emergence of some apparent resistance is discussed for different cases of inductive as well as of noninductive coils wound with nonideal Type-II superconductors and placed into an external magnetic field oscillating with some low frequency. For the situation where these coils can be regarded as concentrated elements of an electric circuit the general expression for the terminal voltage of the coils was derived along with equations determining the decay of the current in the closed superconducting circuit. The results of experimental investigations of the current decay in such coils and of their terminal characteristics showing a good agreement with the theory are also presented. (auth)

16008 PRESSURE DEPENDENCE OF THE ENERGY GAP ANISOTROPY IN ALUMINUM. Leavens, C. R.; Carbotte, J. P. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 21, 2568-2573(1 Nov 1972).

The superconducting energy gap for a large number of points on the irreducible ($^1/_{48}$)th of the Fermi surface of pure single-crystal aluminum both at zero and finite pressure was calculated. It is found that the energy gap anisotropy in aluminum increases with increasing pressure. (auth)

16009 FLOW STRESS AND YIELD POINT OBSERVATIONS ON NORMAL AND SUPERCONDUCTING INDIUM AND LEAD. Hutchison, T. S.; McBride, S. L. (Royal Military Coll. of Canada, Kingston, Ont.). Can. J. Phys.; 50: No. 21, 2592-2595(1 Nov 1972).

Measurements of the plastic flow stress and 30 MHz ultrasonic attenuation in normal and superconducting 99.9999% pure In and Pb are presented. For both In and Pb, with a strain rate of 10^{-5} s^{-1}, the attenuation change $\Delta\alpha_{ss}$ takes about 3 s while the related flow stress change $\Delta\sigma_{ss}$ takes about 30 s. In indium $\Delta\alpha_{ns}$ and $\Delta\sigma_{ns}$ are completed in about 40 s; in Pb the corresponding times are about 3 s or less. Experimental evidence is presented which shows unequivocally that the dislocation arrangements in the normal and superconducting states are different. (auth)

16010 CRITICAL CURRENTS IN $NbSe_2$: EVIDENCE FOR SURFACE PINNING. Kopp, J.; Huntley, D. J.; Frindt, R. F. (Simon Fraser Univ., Burnaby, British Columbia). Can. J. Phys.; 50: No. 22, 2840-2841(15 Nov 1972).

The variation of critical current density for flux flow with thickness was measured for crystals of $NbSe_2$ between 10^{-6} and 0.03 cm thick. The dominant behavior is that $J_c \propto (\text{thickness})^{-1}$ and this is interpreted as evidence for surface pinning predominating over bulk pinning of the flux lines. (auth)

16011 EFFECT OF ELECTRIC FIELDS ON THE EXCESS ELECTRIC CURRENT OF THE MAKI PROCESS ABOVE THE SUPERCONDUCTING TRANSITION POINT. Koyanagi, M. (Electrotechnical Lab., Tokyo). Phys. Lett.; 42A: No. 6, 433-434 (15 Jan 1973).

Correct expression of the excess conductivity of the Maki process is given under finite electric fields, E, showing a quite different behavior $E^{-\frac{1}{3}}$ ln $(E^{\frac{1}{3}}/a)$ compared with $E^{-\frac{1}{3}}$ of Maki's original in the strong static field limit of films, where $a \propto$ the depairing parameter. (auth)

16012 SUPERCONDUCTIVITY IN THE PSEUDO-BINARY A-15 COMPOUNDS $Mo_3Os_{1-x}Ru_x$ AND $Mo_3Ir_{1-x}Ru_x$. Johnston, D. C. (Univ. of California, La Jolla). Solid State Commun.; 11: No. 12, 1751-1754(15 Dec 1972).

Superconducting transition temperatures (T_c) and room temperature lattice parameters (a_0) are reported for the A15 pseudobinary systems $Mo_3Ir_{1-x}Ru_x$ and $Mo_3Os_{1-x}Ru_x$ ($0 \le x \le 0.8$). If Mo_3Ru could be synthesized in the A-15 structure, its T_c and a_0 are predicted to be 10 to 11°K and 4.95 Å, respectively. (auth)

Equipment and Devices

Refer also to abstracts 15363 and 15365.

16013 POWER CONSUMPTION FOR COMPENSATING HEAT LEAK THROUGH LEADS OF SUPERCONDUCTING DEVICES. Brodyanskii, V. M.; Royzen, L. I.; Abramov, G. I. Heat Transfer - Sov. Res.; 4: No. 6, 170-4(1972).

The specific power losses are determined for compensating heat leaks through electric conductors with allowance for the dependence of efficiency of constant-temperature cryogenic equipment on temperature. Considered here is a current conductor with an idealized heat-removal system providing for minimum power consumption, and the effectiveness of these leads is determined as the ratio of the specific consumption of power for compensating the heat leaks along a lead with an idealized heat removal system. Analyzed are adiabatic conductors with boundary temperatures of 300 to 4.2°K, as well as leads consisting of series-connected adiabatic elements with one, two and three intermediate heat-removal levels. Optimal temperatures of the intermediate heat removal levels are determined which provide for minimum power losses. An analysis is presented of helium-vapor cooled leads at warm-end temperatures of 300°K and of leads the individual segments of which are cooled sequentially by helium, hydrogen and nitrogen vapor. An analysis is carried out of the energy conditions of lead operation, when the evaporability of the helium is due not only to the lead, but also through insulation and thermal bridges. (auth)

16014 CHARACTERISTICS OF PARAMETRIC OSCILLATION IN SUPERCONDUCTING POINT CONTACTS. Vystavkin, A. N.; Gubankov, V. N.; Kuz'min, L. S.; Likharev, K. K.; Migulin, V. V. Radio Eng. Electron. Phys. (USSR) (Engl. Transl.); 17: No. 4, 705-8(Apr 1972).

Translated from Radiotekh. Elektron.; 17: No. 4, 896-8(Apr 1972).

The equivalent circuit of the contact was found on the basis of the Aslamazov–Larkin model, and the possible critical-frequency values were determined. An attempt was made to analyze the parametric interactions in a point contact in the more realistic microwave case of no-load combination frequencies. In view of the fact that the parameter modulation coefficient for self-pumping is inherently not small, this mode of operation differs drastically from the short-circuit mode of operation and has interesting characteristics. (MHR)

16015 SENSITIVITY OF JOSEPHSON JUNCTIONS IN VIDEO DETECTION OF MICROWAVE AND MILLIMETER-WAVE RADIATION. Ohta, H. (Univ. of California, Berkeley). J. Appl. Phys.; 43: No. 12, 5161-3(Dec 1972).

The responsivity and the noise equivalent power (NEP) of Josephson junctions in video detection of microwave and millimeter-wave radiation were calculated. The sensitivity to radiation is assumed to be limited by the rounding of the voltage–current curve due to thermal noise of both the source resistance and the junction resistance. The calculated NEP is at least several tens of times better than any experimentally established. (auth)

16016 LOW HEAT LEAK TEMPERATURE STABILIZED COLUMN TYPE SUPPORT. Heim, J. R. (National Accelerator Lab., Batavia, IL). Cryogenics; 12: No. 6, 444-450(Dec 1972).

The design and analysis of a low heat leak temperature stabilized column type support for large superconducting magnets is presented. Engineering design formulas have been developed for a three tube composite column which uses the cryostat liquid nitrogen radiation shield as a heat sink. Also, the design concept and method of analysis for the general case using many tubes with or without heat sinks is also developed. These simple structural elements conduct negligible amounts of heat to the supported cold mass and may be designed to shrink, grow, or remain unchanged in height when cooled to operating conditions. The three tube specimen presented herein has a collapse load of 9,000 kg and a heat leak of less than 11 mW. (UK)

PHYSICS (NUCLEAR)

16017 (ORO-1316-144) NUCLEAR PHYSICS PROGRESS REPORT, APRIL 1, 1972-MARCH 31, 1973. Phillips, G. C. (Rice Univ., Houston, Tex. Bonner Nuclear Labs.). 1972. Contract AT(40-1)-1316. 24p. Dep. NTIS.

Research progress at the T. W. Bonner Nuclear Laboratories of Rice University for the period April 1, 1972 to March 31, 1973 is briefly summarized. The work included neutron physics, multiparticle break-up, nuclear spectroscopy, nuclear structure, nuclear theory, and certain applied problems. (JWR)

Neutron Interactions with Matter

16018 (AEEW-M-1136) COMPARISON OF LEAP, TOR AND SLAB, PROGRAMMES FOR COMPUTING THE SCATTERING LAW $S(\alpha,\beta)$ FROM A PHONON FREQUENCY FUNCTION. Butland, A. T. D. (Atomic Energy Establishment, Winfrith (England)). Oct 1972. 28p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

Several computer codes have been written to calculate from a phonon frequency function, $\rho(\omega')$, the scattering law, $S(\alpha,\beta)$, describing slow neutron scattering. In this memo an attempt is made to test the accuracy of three such codes, LEAP, TOR and SLAB, against exact calculations for a pseudo-gaussian form of the phonon frequency function, and to compare their output for a more general form of the phonon spectrum. Some consideration is given to the effect of single precision working, and assessments of the computing time are presented for typical cases. Recommendations of the best codes for use in various circumstances are made. (auth)

16019 (AEEW-R-813) THERMAL NEUTRON SCATTER BY GRAPHITE ASSUMING THE CRYSTAL HAS AN ISOTROPIC STRUCTURE. Butland, A. T. D. (Atomic Energy Establishment, Winfrith (England)). Oct 1972. 44p. Dep. NTIS (U. S. Sales Only). UK 1.00 pound.

The development of a set of graphite thermal neutron scattering matrices at eight temperatures in the range 295 to 1800°K, assuming the scatterer has an isotropic crystal structure, is described. The scattering models are developed from measurements by PAGE (1968), using an extrapolation technique which ensures consistency with experimental measurements of specific heat and neutron total cross-section. Calculations of μ, and the mean kinetic energy of the carbon nuclei, are made using the models. The validity of the new models is then examined by comparing with experimental measurements the predicted values of the Maxwellian averaged thermal neutron diffusion coefficient, and the $^{239}Pu/^{235}U$ fission rate ratio in various critical assemblies. (auth)

16020 (BNL-tr-510) ULTRACOLD NEUTRONS. Shapiro, F. L. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, NY), from a Russian report. 44p. (CONF-720601-6). Dep. NTIS.

From International conference on nuclear structure study with neutrons; Budapest, Hungary (31 Jul 1972).

The development of research on ultracold neutrons is surveyed. Topics discussed include methods for producing ultracold neutrons, storage of ultracold neutrons, experiments on the transmission and reflection of ultracold neutrons, and the uses of ultracold neutrons. (JWR)

16021 (EIR-220) AN ANALYTIC TIME-DEPENDENT NEUTRON TRANSPORT BENCHMARK SOLUTION. Ganapol, B. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Aug 1972. 90p. Dep. NTIS (U. S. Sales Only).

The time-dependent monoenergetic neutron scalar flux distribution in an infinite medium is calculated. This distribution results from an isotropic burst of neutrons emitted from a localized source and scattered isotropically throughout a plane infinite medium. (LTW)

16022 (IAE-2137) VERIFICATION OF THE THEORY OF NEUTRON DIFFUSION IN A MEDIUM WITH CHANNELS BY THE IMPULSE METHOD (LARGE CROSS SECTION CHANNEL LATTICE). Zhezherun, I. F.; Laletin, N. I. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The diffusion of thermal neutrons in several anisotropic media was studied by the pulse method. The media were characterized by square latticework of empty channels of square cross section in Be and BeO. The diameter of the channels was larger than the path length in the solid material. Coefficients of diffusion were determined by measurement of the decrements of attenuation of neutrons in blocks of various dimensions. Corrections were made for the finite length of the channels. Longitudinal and transverse diffusion coefficients obtained by experiment agreed with the theoretical ones. (tr-auth)

16023 (KFKI-72-65) SPECTRANS: A COMPUTER CODE FOR STANDARDIZING NEUTRON SPECTRA. Palfalvi, J.; Zarand, P. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Sep 1972. 24p. Dep. NTIS (U. S. Sales Only).

The DPSC code is written for comparison and evaluation of neutron spectra computed or measured by different techniques. The code calculates the spectra in 48 predetermined points independently from the original interval distribution of the input spectra. The code computes kerma and rem-dose spectra as well as dose fraction from the standardized neutron spectra. The calculated spectra are written on a library tape and drawn by an off-line plotter. (auth)

16024 (LA-4963) LAPHAN: A CODE TO COMPUTE THE P_0 TO P_4 MULTIGROUP PHOTON-PRODUCTION MATRICES. Dudziak, D. J.; Bosler, G. E. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 15p. (ENDF-182). Dep. NTIS.

The LAPHAN code is a revision and extension of previous codes in the LAPH series, LAPH and LAPHANO. Photon-production cross-section and angular distribution data are retrieved from the ENDF Files 12 through 15, processed into specified photon and neutron energy groups, and combined as necessary to produce up to P_4 photon-production matrices and photon-energy-production matrices. Production cross sections are averaged over neutron fine groups and then collapsed into a given broad-group structure using specified weighting functions. Input is in DTF-IV format, and output matrices are in either DTF-IV or FIDO format. The code is written in ANS standard FORTRAN for computers with a $65K_{10}$ memory. (1 figure, 1 table) (auth)

16025 (LA-DC-72-1382) NEUTRONIC ANALYSIS OF A TRITIUM-PRODUCTION INTEGRAL EXPERIMENT. Muir, D. W. (Los Alamos Scientific Lab., N. Mex.); Wyman, M. E. (Illinois Univ., Urbana). 1972. 14p. (CONF-721111-12). Dep. NTIS.

From international meeting on the technology of controlled thermonuclear fusion experiments and the engineering aspects of fusion reactors; Austin, TX (20 Nov 1972).

An integral measurement of tritium production in a 30-cm-radius sphere of lithium deuteride was analyzed using multigroup cross sections and a discrete ordinates transport code. The dependence of the calculated results on the order of angular quadrature, the degree of the Legendre expansion of the cross sections, the radial fine-mesh size and the source diameter were studied. A satisfactory combination of these parameters was used to produce a "reference" calculation of the results. The reference calculation is in generally good agreement with the experiment, although some 20% differences are observed. (auth)

16026 (ORNL-TM-3960) ORNL BENCHMARK EXPERIMENT FOR NEUTRON TRANSPORT IN THICK SODIUM. Maerker, R. E.; Muckenthaler, F. J.; Clifford, C. E. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 35p. (CONF-720901-16). Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Kiamesha Lake, NY (12 Sep 1972).

The description of an experiment performed at the Tower Shielding Facility (TSF) is presented which provides verification of cross-section accuracy for use in transport calculations of deep penetration of neutrons through 15 ft of sodium. Results of calculations of the experiment are presented which were obtained by using the MORSE multigroup Monte Carlo code to calculate the transport based on the ENDF/B-III cross-section set for sodium. Comparison of the calculations with experiment indicates that the total neutron leakage above thermal energies penetrating 15 ft of sodium can be calculated to within ~30% and neutrons penetrating up to 10 ft of sodium to within ~10%. (auth)

16027 (RT/FI-(72)43) MODIFIED VERSION OF THE RIGEL CODE. Gheorghe, D.; Salvatores, M. (Comitato Nazionale Per L'Energia Nucleare, Rome (Italy)). Oct. 1972. 39p. Dep. NTIS (U.S. Sales Only).

A complete series of checks on the ENDF/B tapes processing code, RIGEL, indicated the need for several changes to run all the capabilities of the code successfully. The modifications

which gave rise to a modified version of the RIGEL code are described in detail. (auth)

16028 (TID–26215(Suppl.)) CINDA 72: AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. Supplement. (Technical Information Center (AEC), Oak Ridge, Tenn. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut. ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Nov 1972. 238p. Unipub, Inc., New York, N. Y. $28.00.

16029 SPECIFICATION AND TESTING OF NUCLEAR DATA REQUIRED FOR MONTE CARLO TRANSPORT CALCULATIONS. Cashwell, E. D. (Los Alamos Scientific Lab., N. Mex.); Plechaty, E. F. Nucl. Sci. Eng.; 49: No. 3, 394-5(Nov 1972).

A class of Monte Carlo neutron transport codes use evaluated neutron cross sections in the detail that the data are presented by the evaluator. However, recent evaluations are shown to require storage allocations such that practical problems cannot be calculated even in the largest computers. (auth)

16030 MEASUREMENT AND ANALYSIS OF FAST NEUTRON SPECTRA IN URANIUM DEPLETED IN THE ^{235}U ISOTOPE. Kaushal, N. N.; Malaviya, B. K.; Becker, M.; Burns, E. T.; Gaerttner, E. R. (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng.; 49: No. 3, 330-48(Nov 1972).

Fast neutron spectra in a cuboidal assembly of uranium depleted in the ^{235}U isotope have been measured for the purpose of providing integral checks on cross-section data pertinent to fast reactor development. Spectral measurements have been made at three different radial distances and several different angles, and cover an energy range from 10 keV to 10 MeV. The experimental spectra are compared with S_n transport calculations involving ENDF/B-I, ENDF/B-II, KEDAK (from Karlsruhe) files, and a multigroup set from Argonne National Laboratory and conclusions are drawn as to the adequacy of these data for predicting measured spectra. Extensive use is made of the continuous slowing down theory to pinpoint specific areas of uncertainty in the cross-section data. From a comparison of the experimental spectra with the calculations, it is concluded that the neutron capture cross-section data in the ^{238}U ENDF/B files should be lowered by about 10% in the range 10 to 40 keV. Additionally, the slowing down effectiveness of inelastic scattering in the range 40 to 500 keV should be lowered by about 25%. Discrepancies among various data files are also observed in the inelastic slowing down effectiveness in the range 1 to 2 MeV. (auth)

16031 MONTE CARLO STUDIES OF D_2O AND H_2O NEUTRON MODERATORS FOR TIME OF FLIGHT EXPERIMENTS. Camarda, H. S. (National Bureau of Standards, Washington, DC). Nucl. Instrum. Methods; 106: No. 2, 205-212(1973).

Calculations of neutron moderation in finite D_2O and H_2O media have been performed. Neutron spectrum shapes, time delays, and time smearings have been determined over a neutron energy range $1.8 \text{ keV} \leq E \leq 1 \text{ MeV}$. (auth)

Nuclear Properties and Reactions, A ≤ 5

Refer also to abstracts 15908, 16041, 16047, 16056, 16120, 16229, and 16240.

16032 (BNWL–1685, pp 75-92) FUSION CROSS SECTION THEORY. Duane, B. H. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

Theoretical and experimental cross section measurements are given for the following six most important fusion reactions [T(d,n)^{4}He, ^{3}He(d,p)^{4}He, D(d,p)T, D(d,n)^{3}He, T(t,2n)^{4}He, T(^{3}He,X)Y]. The data covered the energy range from 10 keV to 10 MeV. (MOW)

16033 (DNPL/NSF/R–1, pp 57-64) POLARIZED TARGETS FOR LOW ENERGY NUCLEAR SCATTERING. Berovic, N. (Univ. of Birmingham, Eng.). 1972.

From Symposium on polarized beams; Daresbury, England (10 Jan 1972).

The use of polarized targets in scattering experiments is discussed, and the dependence of the scattering amplitude on the spins and momenta of initial and final states. Investigations both for N–N and N- nucleus systems are referred to. The polarized proton target operating with a polarized deuteron beam on the A.V.F. cyclotron at Birmingham University is described. (UK)

16034 (FRNC-TH-266) ANALYSIS OF THREE-NUCLEON REACTIONS USING THE FADDEEV EQUATIONS. Durand, Mireille (Grenoble Univ. (France)). 1972. 162p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Universite Scientifique et Medicale de Grenoble (France).

As approximate analysis yields insufficient results for three-nucleon reactions, the exact formalism of the Faddeev equations was used. The mathematical formulation of the scattering amplitudes leads to a considerable reduction of the integrals in the case of separable interactions. At low energies, the Yamaguchi potential appears to be sufficient; but for incident nucleon energies greater than 20 MeV, it is necessary to take higher-wave nucleon interactions into account. The Tabakin potential was then used to evaluate the amplitudes due to simple, double, and triple scattering terms (two iterations of the integral equations): the results of the calculations were then compared with the experimental results. The phase shifts of the nucleon–deuteron elastic scattering at various energies between 0 and 40 MeV and for angular momenta greater than unity are presented. (France)

16035 (ITF–72–95–P) DIFFRACTIONAL PROTON SCATTERING AND THE STRUCTURE OF ^{6}Li. Dotsenko, I. S.; Fursa, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

The proton scattering by ^{6}Li is considered in a diffractional approximation. The cluster wave functions were used to describe the states of ^{6}Li. The formula (which describes the diffractional cross sections of elastic and inelastic scattering with the 3^+ level excitation) is obtained in an analytical form. These cross sections are calculated at the energy 185 MeV. The parameter value detached by associations in ^{6}Li is obtained from the condition of the best agreement between the calculated and experimental cross sections. (auth)

16036 OFF-SHELL EFFECTS IN TRITON BINDING-ENERGY AND FORM-FACTOR CALCULATIONS. Haftel, M. I. (Naval Research Lab., Washington, DC). Phys. Rev., C; 7: No. 1, 80-95 (Jan 1973).

The triton binding energy and charge form factor are calculated for a set of phase-shift-equivalent, S-wave, spin-independent potentials. The Faddeev equations are solved by the method of Padé approximants. A partial wave expansion for the triton form factor is presented for a $J = 0$ spatially symmetric wave function. A 6 MeV variation in triton binding energy results occurs for the potentials studied. All but 1 MeV of this off-shell variation is attributable to changes in the deuteron wave function. The relation between the triton binding energy and deuteron wave function is discussed. It is found that the triton binding energy is sensitive to the relative amount of scale distortion in the momentum-space deuteron wave function. For the potentials studied, less binding in the triton is associated with deuteron wave functions that are more "compressed," i.e., fall off more rapidly in momentum space for $k < 2 \text{ fm}^{-1}$. It is also found that potentials that yield less binding in the triton (in worse agreement with experiment) yield a diffraction minimum in the form factor at smaller momentum transfer (in better agreement with experiment). The disparity between the binding-energy results and form-factor results with respect to experiment may indicate a role for three-body forces in the three-nucleon system. (8 figures, 3 tables) (auth)

16037 SEPARABLE-INTERACTION MODEL FOR THE D(p,2p) REACTION. Wallace, J. M. (Univ. of Maryland, College Park). Phys. Rev., C; 7: No. 1, 10-18(Jan 1973).

The differential cross section $(d\sigma/dE d\Omega^2)$ for the D(p,2p) reaction at proton laboratory energies of 20, 45, and 100 MeV is calculated in an exactly soluble model of the three-nucleon system. The model is essentially that of Aaron, Amado, and Yam with the exception that the spin-dependent S-wave separable two-nucleon scattering amplitude is modified to fit two-nucleon elastic scattering data at energies above 20 MeV. The coupled integral equations for the model three-nucleon system are solved iteratively, so that the Faddeev–Watson nuclear multiple-scattering series is generated. The multiple-scattering series, itself, is found to diverge at all energies below 100 MeV. The diagonal Padé approximants, which converge quite rapidly, are employed to sum the series. The results of the calculations are in reasonable agreement with experiment. (4 figures) (auth)

16038 STUDY OF $\pi^\pm$ ELASTIC SCATTERING ON ^{3}He AND ^{4}He AT 100 MeV. Falomkin, I. V. (Joint Inst. for Nuclear Research, Dubna, USSR); Georgescu, C.; Kulyukin, M. M.; (and others). Lett. Nuovo Cim.; 5: No. 18, 1121-4(30 Dec 1972).

Angular distributions, cross sections, and phase shifts were obtained for the elastic scattering of π^+ and π^- on ^{3}He and ^{4}He

at 100 MeV in a streamer-chamber study of π scattering on light nuclei. The differences between the angular distributions on ^{3}He and ^{4}He both for π^+ and π^- were also obtained. (LBS)

16039 TOTAL MUON CAPTURE RATES AND THE AVERAGE NEUTRINO ENERGY. Bernabeu, J. (CERN, Geneva). Nucl. Phys.; A201: No. 1, 41-48(1973).

A method of avoiding the uncertainty associated with the average neutrino energy v in the usual closure approach to muon capture rates is discussed. Instead of neglecting the kinematic dependence on each particular channel, the partial capture rate is approximated by a first-order expansion around v. After the sum over the final states is performed, the result is quite independent of the specific value of v. Application to ^{3}He, ^{6}Li and closed-shall nuclei is given, as an effective test of the nuclear models used. (auth)

16040 BETA RAY SPECTRUM AND THE AVERAGE BETA ENERGY OF SEVERAL ISOTOPES OF INTEREST IN MEDICINE AND BIOLOGY. Mantel, J. (Wayne State Univ., Detroit). Int. J. Appl. Radiat. Isotop.; 23: No. 9, 407-13(Sep 1972).

The beta ray spectra and the average energy were calculated for 59 isotopes of interest in medicine and biology. For each isotope, the average energy, the beta ray spectrum, and a table including the pertinent input data used for computation is given. (auth)

Nuclear Properties and Reactions, $6 \leq A \leq 19$

Refer also to abstracts 14838, 15463, 16039, 16040, 16065, 16069, 16073, 16094, 16105, 16119, 16120, 16126, 16168, 16199, 16224, 16226, 16228, 16229, 16233, and 16241.

16041 (COO-1265-126) ANNUAL REPORT, 1972. (Minnesota Univ., Minneapolis. John H. Williams Lab. of Nuclear Physics). Aug 1972. Contract AT(11-1)-1265. 193p. Dep. NTIS.

ALUMINUM-27—deuteron inelastic scattering at 20 MeV, coupled-channel analysis of, (T)
—deuteron inelastic scattering at 18 MeV, angular distributions for, (E)
—alpha inelastic scattering at 235 MeV, angular distributions for, (E)
AMERICIUM-24—energy levels from proton transfer reactions, orbital assignments for, (E)
BERKELIUM-249—energy levels from proton transfer reactions, orbital assignments for, (E)
BORON-10—triton reactions (t,p) at 10 MeV, DWBA calculation of angular distributions for, (T)
CADMIUM-114—proton elastic and inelastic scattering at 18.6 MeV, coupled channel analysis of angular distributions for, (T)
HELIUM-3—helium-3 scattering by, analysis using resonating group theory, (T)
—neutron elastic scattering at 2.5 to 17.5 MeV, optical model analysis of, (T)
—proton elastic scattering at 2.4 to 10.7 MeV, optical model analysis of, (T)
HELIUM-4—proton scattering at 23 to 74 MeV, Majorana component in imaginary potential for, (T)
—alpha elastic scattering at 18 to 29.5 MeV, α spectra and angular distributions for, (E)
—helium-3 scattering by, analysis using resonating group theory, (T)
HYDROGEN—proton scattering at 16 MeV, proton spectra from, (E)
INSTRUMENTS—development at University of Minnesota John H. Williams Laboratory
IRON-56—helium-3 reactions (He-3,$\alpha\gamma$) at 18 and 27 MeV, γ spectra from, (E)
LEAD-208—proton reactions (p,n) at 24.8 to 50 MeV, with isobaric analog excitation DWBA analysis of, (E/T)
MOLYBDENUM-98—energy levels from molybdenum-100 (p,t) reactions, spin assignments for, (E)
NEON-22—proton reactions (p,t) at 39.8 MeV, coupled-channel Born-approximation calculation for, (T)
NICKEL-58—alpha elastic scattering at 20.5 to 29.5 MeV, analysis of angular distributions for, (E)
—proton inelastic scattering at 20 and 100 MeV, analysis of spin-flip in, (T)
OXYGEN-17—helium-3 reactions (He-3,d) at 25 MeV, angular distribution for, (T)
PROTACTINIUM-231—energy levels from proton transfer reactions, orbital assignments for, (E)
RUTHENIUM-100—energy levels from ruthenium-102 (p,t) reactions, spin assignments for, (E)
RUTHENIUM-102—proton reactions (p,t) at 19 MeV, angular distributions for, (E)
SILICON-29—energy levels of, collective model calculation of spectroscopic factors and transition rates for, (E)
TELLURIUM-122—proton reactions (p,t) at 19 MeV, angular distributions for, (E)
TELLURIUM-123—energy levels from tellurium-125 (p,t) reactions, (E)
TITANIUM-47—deuteron elastic scattering at 19 MeV, angular distributions for, (E)
VAN DE GRAAFF ACCELERATORS—accelerator tubes for University of Minnesota tandem, beam optics manipulations in
ZINC-68—proton elastic and inelastic scattering at 18.6 MeV, coupled channel analysis of angular distributions for, (T)
ZIRCONIUM-90—proton elastic and inelastic scattering at 18.6 MeV, coupled channel analysis of angular distributions for, (T) (JWR)

16042 (COO-1717-3) STRUCTURE STUDIES IN LIGHT NUCLEI WITH NEUTRONS. Lane, R. O. (Ohio Univ., Athens (USA). Tandem Accelerator Lab.). 27 Oct 1972. 58p. (CONF-720701-8). Dep. NTIS.

From International conference on nuclear structure study with neutrons; Budapest, Hungary (31 Jul 1972).

Nuclear structure studies in light nuclei with neutrons are surveyed. The inherent problems in studies of this type are discussed. (JWR)

16043 (COO-1764-164) ZERO ORBITAL ANGULAR MOMENTUM TRANSFER REACTIONS INDUCED BY ^{6}Li IONS. Clement, C. F. (Minnesota Univ., Minneapolis. Atomic Energy Research Establishment, Harwell (England)); Perez, S. M. (Cape Town Univ. (South Africa). Dept. of Physics). 1972. 42p. Dep. NTIS.

An example of such a reaction is the mutual excitation of ^{6}Li ions to their T = 1, 0^+ states at 3.56 MeV. An experimental angular distribution for this reaction is fitted using a distorted-wave theory and also an extension of the adiabatic theory of Austern and Blair. Reasonable fits are obtained in terms of one parameter, the strength of the spin-flip, isospin-flip component of the effective nucleon–nucleon force. Applications of the theory to similar reactions and the inclusion of exchange terms in the amplitude are considered. (3 figures, 3 tables) (auth)

16044 (INP-805) RESONANCES IN BACK ANGLE SCATTERING OF ALPHA PARTICLES ON O, Mg, Al, Si, Ca, Ni, Co, AND Cu NUCLEI. Czabanski, R.; Kapuscik, A.; Micek, S.; Ploskonka, J.; Szmider, J.; Wrobel, Z.; Zastawniak, L.; Zybert, R. (Institute of Nuclear Physics, Krakow (Poland)). Jun 1972. 26p. Dep. NTIS (U. S. Sales Only).

Excitation functions for elastic scattering of alpha particles on O, Mg, Al, Si, Ca, Ni, Co, Cu and Au nuclei were measured at 179° in lab system. The measurements were performed in the alpha energy range from 22.75 MeV to 28.40 MeV in about 250 keV steps. Pronounced maxima in the energy dependence of cross sections were found for O, Mg, Al, Si, Ni, Co and Cu nuclei. (auth

16045 (JINR-D1-6349, pp 140-52) POSITIVE PION PRODUCTION IN NUCLEAR REACTIONS INDUCED BY 185 MeV PROTONS. Dahlgren, S.; Grafstroem, P.; Hoeistad, B.; Asberg, A. (Gustaf Werner Inst., Uppsala).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The differential cross section for π^+ production in a ^{12}C target by 185-MeV protons was measured at laboratory angles between 20° and 130°. The differential cross sections are presented as a function of excitation energy of the residual nucleus. The structure observed in the π^+ spectrum is discussed. A preliminary result with a ^{9}Be target is also presented. The two spectra at 90° and 40° are found to exhibit the same behavior as in the carbon case, i.e., the level structure of ^{10}Be appears clearly, and the cross section is enhanced at smaller angles. (LBS)

16046 (JINR-D1-6349, pp 221-40) PION SCATTERING ON NUCLEI BELOW 1 GeV. Stroot, J.-P. (CERN, Geneva).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Experimental aspects of π^+ elastic scattering on carbon-12 at 115 MeV, 167 MeV, and 241 MeV and π^- elastic scattering on carbon-12 at 120 MeV, 180 MeV, and 260 MeV, reported by the Texas group and the Orsay–Belgian group at CERN, respectively,

are reviewed. Measurements of π^- elastic scattering on helium-4 by both Dubna and CERN are also reported. Theoretical aspects of π^- nucleus scattering are discussed. (LBS)

16047 (JINR-D1-6349, pp 449-74) CAPTURE OF MU MESONS BY COMPLEX NUCLEI. Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Muon–nucleon interaction constants and the following reactions in nuclei are discussed: $\mu^- + {}^3He \rightarrow {}^3H + \nu$, $\mu^- + {}^{12}C \rightarrow {}^{12}B + \nu$, $\mu^- + {}^{16}O \rightarrow {}^{16}N + \nu$. Giant resonance excitation during muon capture by nuclei and the spectra and asymmetry of high-energy neutrons are considered. (5 figures, 3 tables). (KSW)

16048 (ORO-1316-146) NUCLEAR STRUCTURE AT INTERMEDIATE ENERGIES. Progress Report, April 1, 1972–March 31, 1973. Phillips, G. C. (Rice Univ., Houston, Tex. Bonner Nuclear Labs.). 1972. Contract AT(40-1)-1316. 19p. Dep. NTIS.

The year has seen a continuation of experimental and theoretical studies of intermediate energy physics and an extension of development of required instrumentation and applications to medical problems. Experiments have been carried out at the Space Radiation Effects Laboratory (SREL) in the areas of small angle proton and pion multiple scattering, Coulomb-nuclear interference total cross section measurements, and pion therapy dosimetry. Experiments were started in multi-particle final state measurements. During the year a portable laboratory was constructed in a Fruehauf trailer and an on-line computer system installed that is especially designed for use with many multi-wire proportional counters at LAMPF at high data rates. (auth)

16049 (ORO-4028-4) RESEARCH IN NUCLEAR CHEMISTRY. Annual Progress Report. Gordon, G. E.; Viola, V. E. Jr.; Walters, W. B. (Maryland Univ., College Park. Dept. of Chemistry). 1 Nov 1972. Contract AT(40-1)-4028. 63p. Dep. NTIS.

ACTIVATION ANALYSIS—development of photon, for analysis of atmospheric particulate material
AEROSOLS—analysis of particulate material in, by instrumental photon activation
BISMUTH-209—alpha fission at 140 MeV, angular correlation of fragments from, (E)
CARBON-12—proton reactions at 65 to 100 MeV, cross sections for A = 6 to 11 products in, (E)
CYCLOTRONS—experimental facilities at University of Maryland, development of
SELENIUM-83—beta decay of isomeric, γ spectra from, (E)
URANIUM-226—alpha decay of, half-life for, (E)
URANIUM-238—alpha fission at 140 MeV, total and compound-nucleus cross sections for, (E) (JWR)

16050 ISOSPIN-FORBIDDEN PARTICLE DECAY OF THE LOWEST T = 2 STATE IN ^{16}O. Koh, T. K.; Falk, W. R.; Davidson, N. E.; Nelson, J. M. (Univ. of Manitoba, Winnipeg). Phys. Rev., C; 7: No. 1, 50-56(Jan 1973).

The isospin-forbidden proton and α-particle decay modes of the lowest T = 2 state in ^{16}O-(E_{exc} = 22.717 MeV) were measured using the reaction $^{18}O(p,t)^{16}O$ at E_p = 43 MeV. Decay protons and α particles to states in ^{15}N and ^{12}C, respectively, were detected in coincidence with outgoing tritons. Proton branching ratios of (25 ± 6)%, (22 ± 5)%, and (15 ± 5)% to the ground state, (5.27 + 5.30), and 6.32-MeV states were obtained. The total α-particle branching ratio to the ground state and 4.44-MeV state in ^{12}C is zero within the experimental uncertainties. These results thus indicate that a branch of about 37% is unaccounted for by proton and α-particle decay to the low-lying states of ^{12}C and ^{15}N. (auth)

16051 THREE-NUCLEON TRANSFER TO MIRROR STATES IN ^{17}O AND ^{17}F. Bingham, H. G.; Fortune, H. T.; Garrett, J. D.; Middleton, R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 7: No. 1, 57-60(Jan 1973).

The highly selective reactions $^{14}N(^6Li,^3He)^{17}O$ and $^{14}N(^6Li,t)^{17}F$ were used to populate mirror states below 7 MeV in ^{17}O and ^{17}F. Negative-parity states were populated much more strongly than positive-parity states. The strongest state observed in ^{17}F is a new state at E_x = 5.220 ± 0.01 MeV, which is identified as the mirror of the 5.217-MeV state in ^{17}O. (2 figures, 1 table) (auth)

16052 NEW STATE AT 4.593 MeV IN ^{19}Ne. Bingham, H. G.; Fortune, H. T.; Garrett, J. D.; Middleton, R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 7: No. 1, 60-62(Jan 1973).

Analysis of data from the $^{16}O(^6Li,t)^{19}Ne$ reaction shows that the tentative new 4.59-MeV state in ^{19}Ne is indeed present. As a result, a state is missing in the corresponding region of excitation in ^{19}F. Possible mirror correspondences are discussed. (2 figures, 1 table) (auth)

16053 STRUCTURE OF THE 8.65–8.69-MeV DOUBLET IN ^{11}C. Fortune, H. T.; Bingham, H. G.; Garrett, J. D.; Middleton, R. (Univ. of Pennsylvania, Philadelphia). Phys. Rev., C; 7: No. 1, 136-40(Jan 1973).

The 8.65- and 8.69-MeV states in ^{11}C were studied with the $^{10}B(^3He,d)^{11}C$ reaction, with a resolution of 9 keV (full width at half maximum). Comparison of absolute spectroscopic strengths for this reaction and for the $^{10}B(d,p)^{11}B$ reaction to the 9.19-MeV (J^π = $^7/_2^+$) and 9.27-MeV (J^π = $^5/_2^+$) states in ^{11}B shows unambiguously that the spin sequence in ^{11}C is the same as in ^{11}B. An additional outcome of the present experiment is a measurement of the width of the 8.69-MeV state: Γ_{TOTAL} = 15 ± 1 keV. The natural width of the 8.65-MeV state is considerably less than the experimental resolution width of 9 keV. (5 figures, 2 tables) (auth)

16054 STUDY OF SOME ^{20}F EXCITED STATES. Pronko, J. G. (Lockheed Palo Alto Research Lab., CA). Phys. Rev., C; 7: No. 1, 127-136(Jan 1973).

Excited states of ^{20}F which de-excite via γ-ray cascades through the 823-keV state were studied using the $^{18}O(^3He,p)$ reaction at a beam energy $E_{^3He}$ = 2.88 MeV. Particle–γ-ray angular correlations in a standard collinear geometry were obtained using NaI detectors for observing those γ rays which were in coincidence with proton groups representing excited states up to 4.3 MeV excitation. The analysis of these data involved the simultaneous fitting of the correlations of all possible cascading γ rays from the state under study, and resulted in the measurement of spins, branching, and multipole mixing ratios for some excited states and their subsequent electromagnetic de-excitations. Coincident γ-ray spectra were also obtained with a Ge(Li) detector, which data provided additional information regarding the more complex decay schemes. Previously unreported lifetime information for the 1824- and 1972-keV states was obtained using the Doppler-shift-attenuation method and the $^{18}O(t,n\gamma)^{20}F$ reaction at a beam energy of $E_t \simeq$ 2.85 MeV. These mean lifetimes are ≤65 fs and ≥1.1 ps, respectively. The combined data for the 1824-keV state, as well as recently reported two-particle-transfer data, suggest that the $J^\pi = 4^+$ and 5^+ members, respectively, of the ground-state rotational band. Data obtained regarding the 1972-keV state suggest that this state has a $J^\pi = 3^-$ assignment, while those for the 2195-keV state imply a $J^\pi = 3^+$ assignment. The results of this experiment are compared with recently reported shell-model calculations. (4 figures, 3 tables) (auth)

16055 ENTRANCE CHANNEL PHENOMENA IN COMPLEX NUCLEAR SCATTERING. Gobbi, A.; Wieland, R.; Chua, L.; Shapira, D.; Bromley, D. A. (Yale Univ., New Haven). Phys. Rev., C; 7: No. 1, 30-43(Jan 1973).

The elastic scattering excitation functions of the systems $^6Li-^6Li$, $^{12}C-^{12}C$, $^{14}N-^{14}N$, $^{16}O-^{14}N$, $^{16}O-^{15}N$, $^{16}O-^{16}O$, $^{16}O-^{18}O$, and $^{18}O-^{18}O$ were subjected to comparative optical-model analyses. The gross structure characteristic of all these excitation functions is shown to arise from potential scattering phenomena. These phenomena were studied in detail. The extracted $^{16}O-^{16}O$ potential was used as input to detailed studies leading to the identification of single partial-wave orbiting resonances of 3- to 4-MeV width. The $^{16}O-^{16}O$ experimental data were also used to test for the possible existence of a variable-moment-of-inertia effect during the interpenetrating collisions; no evidence for such an effect was found, at least in this particular case. New suggestions for the prediction of the imaginary optical-potential parameters were investigated. (14 figures) (auth)

16056 OPTICAL-MODEL PARTIAL-WAVE ANALYSIS OF 1-GeV PROTON–NUCLEUS ELASTIC SCATTERING. Clark, B. C. (Ohio State Univ., Columbus); Mercer, R. L.; Ravenhall, D. G.; Saperstein, A. M. Phys. Rev., C; 7: No. 1, 466-471(Jan 1973).

Partial-wave calculations using the Klein–Gordon and the Dirac equations were performed for the 1-GeV proton scattering experiments of Palevsky, et al. Without the explicit introduction of spin in the optical potential, the two equations give closely similar results. Compared with the eikonal approximation, the differential cross sections of the partial-wave analysis show considerable filling in of the diffraction minima. The simple Watson theoretical optical-potential predictions are compared with phenomenological fits to the data, and substantially the same conclusions as Palevsky, et al., are obtained. The optical potentials used in this work are either the fourth component of a four-vector or a scalar potential. (5 figures, 3 tables) (auth)

16057 ANGULAR DISTRIBUTIONS OF PROTONS NEAR RESONANCE FOR THE REACTION $^{12}C(d,p\gamma)^{13}C$ OBTAINED BY SHAPE STUDIES OF γ-RAY LINES. Tryti, S.; Holtebekk, T.; Rekstad, J. (Univ. of Oslo). Nucl. Phys.; A201: No. 1, 135-144(1973).

Angular distributions of protons from the reaction $^{12}C(d,p\gamma)^{13}C$ were obtained from the shape of the Doppler-shifted γ-ray lines. In particular, the 7-keV-wide resonance at 1449 keV deuteron energy is studied. The distributions as a function of deuteron energy show interference effects which can be explained only by contributions from at least 4 other resonances, or from a direct reaction. The interference is clearly demonstrated by expressing the angular distributions in terms of Legendre polynomials, and studying the different terms in the distributions as functions of beam energy. (auth)

16058 QUASIELASTIC (p,n) STUDIES AND THE ISOSPIN DEPENDENCE OF NUCLEON-NUCLEUS OPTICAL POTENTIALS. Carlson, J. D. Boulder, Colo.; Univ. of Colorado (1972). 191p. University Microfilms Order No. 72-25,151. Thesis.

Quasielastic (p,n) differential cross sections have been measured for 29 nuclei at a proton energy of 22.8 MeV in approximately 7.5° steps from 10 to 152°. The targets included ^{9}Be, $^{25,26}Mg$, ^{27}Al, ^{31}P, ^{40}Ar, ^{49}Ti, ^{50}Cr, $^{54,56,58}Fe$, $^{58,61,62,64}Ni$, ^{64}Zn, $^{90,96}Zr$, ^{93}Nb, ^{96}Mo, $^{96,104}Ru$, ^{115}In, $^{117-120}Sn$, ^{165}Ho, and ^{208}Pb. The results have been analyzed with a distorted-wave Born-approximation in terms of the generalized optical model potential due to Lane. A complex isospin interaction was used. Parameter searches were made in which the radial shape of the imaginary surface peaked portion of the interaction was determined along with the overall interaction strength. The radius and diffuseness parameters which specified the shape of the real volume part of the isospin interaction and the ratio of real to imaginary well depths were fixed at values taken from the Becchetti and Greenlees global set of proton optical potentials. The shape of the imaginary surface peaked part of the isospin interaction which gave the best fit to the quasielastic (p,n) data was found to vary systematically with nuclear mass. As the mass of the target nucleus increased, the imaginary interaction form factor became broader and peaked at a progressively smaller radius relative to the radius of the real part of the isospin interaction. The broadening caused the imaginary part of the isospin interaction to have a tail which extended appreciably beyond the real part of the interaction. The best-fit interaction parameters were used to generate self-consistent neutron optical potentials from proton optical potentials as prescribed by the Lane model. Neutron elastic scattering cross sections calculated using these self-consistent potentials were found to be in good agreement with observed neutron scattering data. (Diss. Abstr. Int., B)

16059 INVESTIGATION OF THE $^{6}Li(e,e'p)$ REACTION AT 1200 MeV. Antuf'ev, Yu. P.; Agranovich, V. L.; Kuzmenko, V. S.; Sorokin, P. V. (Physical-Technical Inst., Kharkov). Phys. Lett.; 42B: No. 3, 347-8(11 Dec 1972).

The reaction $^{6}Li(e,e'p)^{5}He$ has been investigated with a resolution good enough to distinguish the effects of the s- and p-shells of the ^{6}Li nucleus. The reaction cross section has been measured as a function of the missing energy from -15 to +30 MeV. The proton angular distribution has been measured at missing energies of 4 and 20 MeV. The comparison of the data with calculations within the framework of the plane-wave impulse approximation gives the harmonic oscillator parameters q_p = 50 ± 5 MeV/c, q_s = 108 ± 9 MeV/c. (auth)

16060 REACTION (α,t) ON ^{7}Li AND ^{11}B. Vasil'eva, O. I.; Karabanov, N. V.; Lebedev, V. M.; Spasskii, A. V.; Teplov, I. B. (Inst. of Nuclear Physics, Moscow). Yadern. Fiz.; 16: No. 3, 460-4(Sep 1972). (In Russian).

Angular distributions have been measured of the triton groups from $^{7}Li(\alpha,t)^{8}Be$ and $^{11}B(\alpha,t)^{12}C$ reactions, corresponding to the production of ground (0^+) and first excited (2^+) states of ^{8}Be and ^{12}C at several energy values of incident α-particles. Differential excitation curves for $^{7}Li(\alpha,t)^{8}Be$ reaction at θ_{lab} = 20° and for $^{11}B(\alpha,t)^{12}C$ reaction at θ_{lab} = 30° have also been measured. The measurements were carried out in the energy range of bombarding α-particles from 15 up to 25 MeV. From the qualitative analysis of results it is clear that these are direct processes that are basic in the reactions studied. A non-monotonous character of the excitation function in $^{11}B(\alpha,t)^{12}C$ reaction is due to the contribution of intermediate resonance processes. (auth)

16061 STUDIES ON NUCLEI BY USING ELECTRON SCATTERING. Torizuka, Y.; Kimura, M.; Kojima, Y.; Saito, T.; Ito, K. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 4: No. 2, 1-21(Feb 1972). (In Japanese).

Several studies concerning nuclear structure by using electron scattering are presented. Excited states of ^{12}C were observed in the experiment on the inelastic scattering of electrons. Form factors of 0^+, 2^+ and 4^+ levels observed experimentally were calculated with the Nilsson model, where the levels were considered as rotational levels. It was possible to assign Nilsson orbits to the experimentally observed levels. The quadrupole moment and the hexadecapole moment were obtained. Electron scattering by 0^+ and 2^+ states of ^{20}Ne which belong to an excited rotational band were measured. Characteristic form factors were observed. These levels were interpreted on the basis of results of recent many particle transfer experiments. An octupole state which has a similar property as a giant dipole state was seen in excited states of ^{40}Ca around 19 MeV. It was impossible without a strong excitation of an octupole state to explain the form factor of the 19 MeV state. The existence of multipole states other than dipole states is very important in a giant resonance region. A comparison between experiments on Sn isotopes and ^{114}Cd showed a large difference between transition charge densities of Sn isotopes and ^{114}Cd. (Japan)

16062 STUDY OF NUCLEI BY USING ELECTRON SCATTERING. Torizuka, Y.; Kimura, M.; Kojima, Y.; Oyamada, M.; Nakahara, K. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 3: No. 2, 1-24(Dec 1970). (In Japanese).

Experiments concerning giant resonance region of ^{12}C were completed, and analyses have finished. The experiments showed that the spin-isospin mode was distributed over the energy region of the giant resonance, and the mode was not a pure mode but a mixed mode with the isospin mode. A new method of analysis was developed, and it was possible to simplify the analysis of complex spectra of the giant resonance. New excitation modes of 1^-, 2^-, 3^-, 4^-, 1^+, 2^+ and 3^+ predicted theoretically were observed from spectra of shape factors. This fact showed that shell structure was important even for highly excited states in the case of light nuclei. Electron scattering experiments were also performed on the nuclei of ^{20}Ne, ^{24}Mg and ^{28}Si to study nuclear structure of deformed nuclei. The experiment on ^{20}Ne was analyzed by phase shift analysis for elastic scattering and distorted wave Born approximation for inelastic scattering. Configuration of $(1S)^4(1P)^8$ was in good agreement with the result of the elastic scattering. The Tassie model was used for the analysis of scattering with 1.63 MeV level. The result showed some discrepancy. Cross section of electron scattering from the levels of ^{24}Mg and ^{28}Si, which showed typical rotational spectra, was analyzed by using the Nilsson model including Y_{40} deformation in nuclear potential. Results were shown. (Japan)

16063 NUCLEAR DISINTEGRATIONS PRODUCED BY MULTIPLY CHARGED PARTICLES. Kullberg, R.; Otterlund, I.; Resman, R. (Univ. of Lund, Sweden). Phys. Scr.; 5: No. 1-2, 5-12(1972).

Nucleus-nucleus collisions produced in nuclear emulsions by heavy cosmic ray primaries have been analyzed. The kinetic energy of the incident nuclei is larger than 100 MeV/nucleon. The angular and energy distributions of protons with energies <10 MeV and alpha-particles with energies <200 MeV have been studied. Low energy protons and alpha-particles are emitted isotropically in a system moving with a mean velocity component in the forward direction of 0.02 c. It is found that there is an excess of low energy protons which cannot be explained without using extremely low values of the Coulomb barrier. It is also found that evaporation theory cannot account for all the alpha-particles. In high energy nucleus-nucleus interactions alpha-particles are produced partly by emission from disintegrating fragments and partly by a knock-on process in which quasi-elastic collisions between nucleons and alpha-clusters take place. This last statement is supported by the fact that alpha-particles are emitted with high momentum components in the forward as well as in the transverse direction. (auth) (Sweden)

16064 CONTRIBUTION TO INVESTIGATION OF INTERACTIONS OF FAST DEUTERONS WITH ATOMIC NUCLEI. Siles, E.; Tucek, J. (Safarik Univ., Kosice, Czech.). Fyz. Cas.; 21: No. 2-3, 173-6(1971). (In Slovak).

The stripping (N_b + N_s) reactions were studied for which either $N_b \geq 1$ or $N_s \geq 1$. Measurements of multiple scattering, ionization and the angle of the secondary particles were performed. Seven out of the total of 1131 interactions were chosen that were confirmed to be real stripping reactions. A negligible correction was obtained to the cross section given in a previous paper. (NSA of Czech.)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 14798, 14837, 15494, 16039–16041, 16044, 16058, 16061, 16062, 16094, 16105, and 16120.

16065 (JINR-D1-6349, pp 475-95) PHYSICS OF NUCLEAR MU-CAPTURE (EXPERIMENT). Evseev, V. S. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The absorption of negative muons by intermediate and heavy nuclei was explored through a literature survey (54 references). Experimental measurements were made on μ capture by ^{16}O, ^{32}S, and ^{40}Ca, and decay schemes were constructed which illustrated the resulting conversion of the three excited nuclei to $^{16}N \rightarrow {}^{15}N$, $^{32}P \rightarrow {}^{31}P$, and $^{40}K \rightarrow {}^{39}K$, respectively, by the emission of a neutron. Reaction probabilities for proton emission during μ capture were also examined. (12 figures) (KSW)

16066 (JINR-P1-6814) DEFINITION OF THE $(\mu^-,\nu 2n)$ REACTION PROBABILITY IN μ^--CAPTURE IN ^{32}S AND ^{40}Ca. Evseev, V. S.; Roganov, V. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab of Nuclear Problems). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

The absolute probability (per one μ^--capture) of the reaction $(\mu^-,\nu 2n)$ in μ^--capture in ^{32}S and ^{40}Ca was measured by the activation method. Comparison of the available results with the predictions, obtained on the basis of various models of nuclear μ^--capture, and with other experimental data allows one to make a conclusion that μ^--capture by nuclear clusters (quasideuterons) cannot lead to the production of the high energy part of the nucleon spectra in the reaction considered. (auth)

16067 (ORO-3924-12) ANGULAR MOMENTUM EFFECTS IN NUCLEAR REACTIONS. 1972 Progress Report. Natowitz, J. B. (Texas Agricultural and Mechanical Univ., College Station. Cyclotron Inst.). 1972. Contract AT(40-1)-3924. 27p. Dep. NTIS.

Research performed under AEC Contract AT-(40-1)-3924 during the period 1 January 1972 to 31 December 1972 is summarized. Complete fusion cross section measurements have been made with 45 to 180 MeV ^{12}C projectiles incident on Al, Ti, Ni, and Cu targets. These data are compared with various calculated limits to the nuclear angular momentum. Detector telescopes were employed to observe all of the charged species produced when 180 MeV ^{12}C ions are incident on ^{27}Al. Angular distributions and energy spectra for these species have been obtained. Studies of α evaporation from the $^{120}Te^*$ nucleus have continued. Two new experimental systems, one for the rapid transfer of collected recoils, the other for automating track detector experiments, have been constructed. A new technique of particle identification, based on semiempirical range energy calculations is described. (auth)

16068 (RCN—175) NEUTRON CAPTURE IN ^{23}Na. Kopecky, J.; Stecher-Rasmussen, F.; Abrahams, K. (Reactor Centrum Nederland, Petten). Sep 1972. 24p. Dep. NTIS (U.S. Sales Only).

Gamma-ray spectroscopy with Ge(Li) detectors and the measurement of the circular polarization of 12 primary transitions in the $^{23}Na(n,\gamma)$ reaction supports the $J = 1^+$ assignment for the 2.85-keV resonance. No indication for a primary ground-state transition (with an upper intensity limit of $I < 0.01\%$) has been found. The spins of the 3372-keV and the 4442-keV levels have been assigned to be $J = 1^-$ and 2^-, respectively. The lowest member of the triplet at 1.34 MeV is populated by a strong primary transition, while the transition to the highest member is not certain. (6 figures, 2 tables) (auth)

16069 QUASIFREE (p,pα) SCATTERING ON ^6Li, ^{24}Mg, ^{28}Si, ^{40}Ca, ^{140}Ce, AND ^{232}Th AT 156 MeV. Bachelier, D.; Bernas, M.; Bilaniuk, O. M.; (and others) (Institut de Physique Nucleaire, Orsay, France). Phys. Rev., C; 7: No. 1, 165-169(Jan 1973).

Knockout of α particles by 156-MeV protons from ^6Li, ^{24}Mg, ^{28}Si, ^{40}Ca, ^{140}Ce, and ^{232}Th was used to investigate the A dependence of α clustering in nuclei. Protons and α particles were detected in coincidence under conditions of quasi-free scattering. Corresponding reaction cross sections were measured. Cross sections for ^{24}Mg and ^{40}Ca were found to be about 2 orders of magnitude lower than for ^6Li. The cross section for ^{28}Si was found to be about $\frac{1}{3}$ that for ^{24}Mg and ^{40}Ca. Upper limits of the integrated cross sections for ^{140}Ce and ^{232}U are still compatible with a $A^{\frac{1}{3}}$ dependence of the α knockout process. (3 figures, 2 tables) (auth)

16070 (p,t) AND (p,^{3}He) REACTIONS ON ^{27}Al AT $E_p = 27$ MeV. Graetzer, R.; Krausharr, J. J.; Shepard, J. R. (Univ. of Colorado, Boulder). Phys. Rev., C; 7: No. 1, 199-209(Jan 1973).

Levels in ^{25}Al and ^{25}Mg were populated via the (p,t) and (p,^{3}He) reactions with 27-MeV protons on a ^{27}Al target. Angular distributions of emitted tritons and ^3He were measured simultaneously with a detector telescope. Zero-range distorted-wave Born-approximation (DWBA) calculations with simple shell-model configurations for the two transferred nucleons provided satisfactory fits for several of the observed diffraction patterns. A sharp rise in cross section at forward angles was a good indication of the presence of L = 0 transfer, even though transitions occurred with a mixture of L values. Compound-nucleus calculations reproduced the smooth angular-distribution shapes observed for higher excited levels, but predicted cross sections consistently larger than those observed. For the first $\frac{1}{2}^+$ levels neither DWBA, compound-nucleus, nor a direct two-step (p,d) (d,t) calculation was able to give a satisfactory description of the data. (10 figures, 1 table) (auth)

16071 NUCLEAR STRUCTURE CALCULATIONS IN ^{21}Ne AND ^{23}Na. Gunye, M. R. (Tata Inst. of Fundamental Research, Bombay). Phys. Rev., C; 7: No. 1, 216-221(Jan 1973).

The energy levels, static moments, and electromagnetic transition probabilities in ^{21}Ne and ^{23}Na are calculated from the projected multishell Hartree-Fock wave functions obtained with a realistic NN interaction. The modified Elliott interaction is employed as this interaction. The results of these calculations are in good agreement with the experimental data. In particular, the magnetic moment of the ground state and the excitation energy of the first $\frac{1}{2}^+$ state in both the nuclei are predicted accurately. The computed ft values of the β transitions to the states in the two nuclei are in semiquantitative agreement with the experimental data. (2 figures, 4 tables) (auth)

16072 ^{20}Na BETA DECAY. Ingalls, P. D. (Univ. of Colorado, Boulder). Phys. Rev., C; 7: No. 1, 464-465(Jan 1973).

Conflicting data on ^{20}Na β^+ decay are discussed. Estimates show that the process $^{24}Mg(p,2n)^{23}Al(\beta^+)^{23}Mg(0.0$ MeV) (of indistinguishable half-life and endpoint energy) interfered with early measurements of $^{24}Mg(p,\alpha n)^{20}Na(\beta^+)^{20}Ne$ (1.63 MeV). (1 table) (auth)

16073 HARTREE-FOCK CALCULATIONS WITH SKYRME'S INTERACTION. II. AXIALLY DEFORMED NUCLEI. Vautherin, D. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., C; 7: No. 1, 296-316(Jan 1973).

Skyrme's interaction is used in deformed Hartree-Fock calculations of some light and rare earth nuclei. A method of solution is presented which exploits as much as possible the simple features of the Skyrme force in order to allow calculations of heavy deformed nuclei. In the rare earth region pairing correlations are taken into account in a simplified but self-consistent way by considering energy functionals depending also on occupation probabilities. Calculations are made for the two parameter sets which were used in a previous study of double-closed-shell nuclei. The set providing the best fit to ground-state properties of spherical nuclei is also found to give a satisfactory description of nuclear deformations. Comparison is made with other available Hartree-Fock calculations in the case of light nuclei, and a discussion of the importance of various terms in the effective force upon nuclear deformations is given. (6 figures, 5 tables) (auth)

16074 ANTIPAIRING EFFECT IN THE ROTATIONAL STATES OF LIGHT NUCLEI. Goeke, K.; Muether, H.; Faessler, A. (Institut fuer Kernphysik, Juelich, Ger.). Nucl. Phys.; A201: No. 1, 49-65(1973).

Properties of rotational levels of sd shell nuclei are studied in the self-consistent deformed Hartree-Bogoliubov model with a variation performed approximately after angular momentum projection. This formalism, which consists of a constrained Hartree-Bogoliubov theory with an additional pairing potential, is explained in detail. Excitation energies, moments of inertia, pairing correlations, and quadrupole moments of the ground state rotational bands of ^{22}Ne, ^{24}Ne and ^{30}Si are investigated and compared with experimental data. In the calculation all particles are treated alike without the assumption of an inert core, using the effective G-matrix elements of Barrett et al., the Yale-Shakin interaction and the B1 force of Brink and Boeker. It turns out to be important to perform the projection before the variation and not afterwards, since the pairing correlations change drastically in going to higher J-states. In the nuclei ^{24}Ne and ^{30}Si the calculations indicate a phase transition into the unpaired states at $J = 4^+$ and 8^+ respectively. The agreement with experiment is satisfactory and the experimental deviation from the $J(J + 1)$ law is quite well reproduced. In each case the Barrett G-matrix gives the best results, which are, in the case of ^{22}Ne, in good agreement with experimental values. (auth)

16075 ELECTRON SCATTERING BY ^{27}Al. I. Terasawa, T. (Tohoku Univ., Sendai); Nakahara, K.; Oyamada, M.; Saito, H.; Tanaka, E. Kakuriken Kenkyu Hokoku; 4: No. 2, 27-32(Feb 1972). (In Japanese).

Electron scattering experiments of ^{27}Al were performed to study the nuclear structure of ^{27}Al. Form factors of levels up to 8 MeV were measured at the incident electron energy of 250 MeV. A spectrum with ^{12}C was used as a reference spectrum. Elastic and inelastic scatterings by levels of 0.84, 1.10, 2.21, 2.73, 3.00 and 3.68 MeV of ^{27}Al were observed. Form factors of electron scattering were divided into a part of cores and a part of odd particles. A core particle coupling was assumed between the ground state and the 2.73 MeV level to study the form factors of both states. The factor $|F|^2$ of the 2.73 MeV level decreased gradually with the increasing momentum transfer. This fact suggests a strong admixture of E4 component to the E2 component. Form factors for levels of 0.84, 1.01, 2.21 and 3.00 MeV were explained by a weak coupling model. The state of core was considered to be a pure 2^+ state. The form factor for 3.68 MeV level was smaller than that for 0.84 MeV level by one order. This may be due to a strong coupling between ^{26}Mg core and an odd proton. (Japan)

16076 DOPPLER-SHIFT ATTENUATION MEASUREMENTS ON ^{24}Mg BY (α,α') AND (p,p') REACTIONS. Baker, S. I.; Grossett, C. R.; Treado; P. A.; Lambert, J. M.; Beach, L. A (Naval Research Lab., Washington, DC). Nucl. Phys.; A196: No. 1, 197-208(1972).

The (α,α') and (p,p') reactions have been used to populate states in ^{24}Mg in order to measure lifetimes of ten states by the Doppler-shift attenuation method. The shifted γ-rays were observed by a planar 5.6 cm^3 Ge(Li) detector at 90° to the beam at the target in coincidence with the scattered particles observed in either of two particle detectors located symmetrically with respect to the beam. A computer coupled dual two-parameter arrangement permitted concurrent measurements for all states appreciably populated. The present measured transition probabilities are compared with predictions from a truncated j−j coupling shell-model calculation. (auth)

16077 ^{31}P (γ,n) REACTION. Kawamura, N. (Tohoku Univ., Sendai); Endo, Y.; Sato, H.; Miyake, M.; Tsubota, H. Kakuriken Kenkyu Hokoku; 4: No. 2, 42-6(Feb 1972). (In Japanese).

The photoneutron emission processes of ^{31}P and ^{27}Al were investigated. The energy spectra of photoneutrons were different from each other. Energy spectra of photoneutrons of ^{31}P (γ,n) reactions were obtained for the gamma-ray energies of 20.0, 22.0, 24.0 and 26.0 MeV. The shape of the spectrum for E γ = 20.0 MeV was similar to that for 22.0 MeV. The spectra for 24 and 26 MeV of the gamma-ray energy show peaks which correspond to transitions to low-lying states of ^{30}P. Cross sections of the (γ,n) reaction were calculated from the spectra for 20.0 and 22.0 MeV. Most of the neutrons emitted for Eγ = 20 ~ 22 MeV were considered to be ground state transitions. A discussion concerning excitation mechanisms is given in relation to the shell structure. Spectra of photoneutrons of $^{27}Al(\gamma,n)$ reactions are shown. Peaks were hardly determined because of strong excited state transitions. However, energies of excited states of ^{27}Al and energies of the giant resonance structure were obtained for probable peaks. (Japan)

16078 COMPILATION OF INFINITE DILUTION RESONANCE INTEGRALS. I. Van der Linden, R.; De Corte, F.; Van den Winkel, P.; Hoste, J. (Univ., Ghent). J. Radioanal. Chem.; 11: No. 1, 133-41(Jun 1972).

16079 FAST NEUTRON CROSS SECTIONS IN THE 2S–1D SHELL. Norman, G. R.; Prestwich, W. V.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 20, 2385-90(15 Oct 1972).

Total neutron cross sections for six elements in the 2S−1D shell were measured in the energy region 0.8 − 3.0 MeV using a new method. The experiment utilizes the fast neutron flux from a nuclear reactor with the neutron energies being determined by a measurement of their time of flight. From the present results the resonance parameters for aluminum were determined and examined in the context of earlier low energy results for this element. The observed widths, which range to greater than 100 keV, are found to be consistent with compound nucleus formation when the reduced widths are compared with the corresponding low energy data. It is concluded that the observation of resonances with large widths is not sufficient to discount compound nucleus formation. (auth)

16080 REACTION $^{23}Na(p,\alpha_0)^{20}Ne$ BETWEEN 1.8 AND 2.2 MeV. Cisneros, C. (Univ. Nacional de Mexico, Mexico City); Rickards, J.; Flores B. M.; Almanza, R.; Lira, J. Rev. Mex. Fis.; 21: No. 2, 115-121(1972).

The excitation curve for the reaction $^{23}Na(p,\alpha_0)^{20}Ne$ was measured for proton energies between 1.8 and 2.2 MeV. In order to study states in ^{24}Mg, angular distributions were measured on three of the five resonances that exist in this interval, and which had not previously been studied. Spin and parity as well as mixing parameters are proposed for two of these resonances (E_p = 2.170 and 2.129). The third at E_p = 2.080 is a double level; this became clear when the angular distributions were measured at the two edges of the wide resonance at E_p = 2.076 and 2.088. A table is given of possible analog resonances in this reaction. (1 figure, 2 tables) (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 15494, 16039–16041, 16044, 16058, 16061, 16066, 16069, 16078, 16094, 16105, 16109, 16113, 16116, 16120, 16126, 16154, 16168, 16199, and 16241.

16081 (AD–735166) PHOTONUCLEAR RESEARCH. Final Technical Report. Sund, R. E.; Verbinski, V. V. (Gulf Radiation Technology, San Diego, Calif.). 26 Feb 1971. Contract N00014-69-C-0064. 44p. (GULF-RT–10532). NTIS.

The absolute ^{60}Ni (γ,n) and Fe (γ,n) differential cross sections at 93° with respect to the incident bremsstrahlung beam were measured near the thresholds for ^{60}Ni and ^{56}Fe, respectively. Time-of-flight techniques were used to determine the neutron energy. For each target, two measurements were done with different bremsstrahlung end points to determine the levels to which the neutrons decay. The absolute bremsstrahlung spectra were determined from neutron time-of-flight measurements for the D (γ) reaction and from the known D (γ) cross section. The ^{60}Ni (γ,n) data show numerous peaks in the neutron energy region up to 75 keV; of these, five definitely decay to the ^{59}Ni ground state. The Fe (γ,n) data had strong peaks at neutron energies in the laboratory system of 2.1 and 10.0 keV; the results indicate that the 2.1-keV peak decays to the 0.411-MeV state in ^{55}Fe and that the 10.0-keV peak decays to the ^{55}Fe ground state. Resonance parameters for ^{60}Ni and ^{56}Fe states are given for the observed, strong, isolated peaks. (auth)

16082 INVESTIGATION OF ^{46}K AND ^{46}Ca WITH $(p,^3He)$ AND (p,t) REACTIONS AT 42 MeV. Daehnick, W. W. (Univ. of Pittsburg); Sherr, R. Phys. Rev., C; 7: No. 1, 150-60(Jan 1973).

The reactions $^{48}Ca(p,^3He)^{46}K$ and $^{48}Ca(p,t)^{46}Ca$ were studied simultaneously with a counter telescope at a beam energy of 41.65 MeV. Experimental resolution for the reaction products was 50 keV for tritons and 90 keV for ^3He. Angular distributions from 20 to 60° were obtained for 12 low-lying states in ^{46}K, for 8 of their T = 4 analogs in ^{46}Ca, and for 14 lower-lying (T = 3) states in ^{46}Ca. Comparison of the angular distributions with those for known final states and with distorted-wave Born-approximation calculations allowed L assignments for most of the observed transitions. The combination of $^{48}Ca(p,t)^{46}Ca$ (analog) and $^{48}Ca(p,^3He)^{46}K$ results helped resolve some divergent J^π suggestions for ^{46}K found in the literature. At least three ^{46}Ca levels at the location of the unnatural-parity T = 4 analog states for ^{46}K were excited in $^{48}Ca(p,t)$ with about 10% of the strength of the neighboring natural-parity T = 4 states. This finding seems to indicate that the familiar one-step zero-range interpretation of (p,t) transfers in this case is less reliable than usual. Another unexpected result was the failure to see a strong 0^+ state in $^{48}Ca(p,^3He)^{46}K$. (5 figures, 3 tables) (auth)

16083 PROJECTED HARTREE–FOCK AND HARTREE–FOCK–BOGOLIUBOV SPECTRA FOR EVEN Ti, Cr, AND Fe ISOTOPES. Chandra, H.; Rustgi, M. L. (State Univ. of New York, Buffalo). Phys. Rev., C; 7: No. 1, 180-190(Jan 1973).

Projection of good angular momentum states was performed for the deformed self-consistent solutions of even Ti, Cr, and Fe isotopes for the central Yukawa and Kuo−Brown interactions. The results from the two interactions were generally similar, although striking dissimilarity in the level spacings was also observed in quite a few cases. The percentage composition of the different angular momentum states in a given deformed solution was also calculated and compared for both interactions. The energy spectra, when compared with the known experimental results, were found to agree qualitatively. (5 figures, 5 tables) (auth)

16084 LEVEL STRUCTURE OF ^{48}Ti FOR E_x < 3.5 MeV. Bardin, T. T.; Becker, J. A.; Fisher, T. R. (Lockheed Palo Alto Research Lab., CA). Phys. Rev., C; 7: No. 1, 190-199(Jan 1973).

The reactions $^{48}Ti(p,p')$, $^{48}Ti(\alpha,\alpha')$, $^{48}Ti(^{35}Cl,^{35}Cl')$, and $^{48}V(\beta^+)$ were employed to measure excitation energies, lifetimes, and γ-decay branching ratios for ^{48}Ti levels with E_x < 3.5 MeV. The

results for excitation energies (in keV) and corresponding lifetimes (in ps) are 983.35 ± 0.10, 6.0 ± 1.3; 2295.5 ± 0.15, 2.4 ± 0.6; 2420.3 ± 0.15, 0.035 ± 0.007; 2997.4 ± 0.25, 0.160 ± 0.032; 3223.5 ± 0.20, $0.042^{+0.018}_{-0.014}$; 3239.7 ± 0.35, $0.044^{+0.018}_{-0.018}$; 3358.7 ± 0.65, 0.350 ± 0.087; and 3370.7 ± 0.30, 0.018 ± 0.007. Reduced electromagnetic-transition matrix elements were also derived from the data. No evidence was found for a doublet at an energy of 3.224 MeV. The previous data on the 3.224-MeV level were reexamined in the light of the present results, and the tentative assignment $J^\pi = 3^+$ was consistent with all data. A tentative assignment of $J^\pi = 4^+$ was given to the level at 3.240 MeV. The present results are in reasonable agreement with the predictions of a model in which the valence nucleons are confined to the $f_{\frac{7}{2}}$ orbital. (6 figures, 5 tables) (auth)

16085 ^{16}O-INDUCED TRANSFER REACTIONS ON fp-SHELL TARGET NUCLEI. I. THE (^{16}O, ^{15}N) ONE-PROTON TRANSFER REACTION. Koerner, H. J.; Morrison, G. C.; Greenwood, L. R.; Siemssen, R. H. (Argonne National Lab., IL). Phys. Rev., C; 7: No. 1, 107-121(Jan 1973).

The (^{16}O,^{15}N) one-proton-transfer reaction was investigated for fp-shell targets ranging from ^{40}Ca to ^{70}Zn at incident energies E(^{16}O) = 42.0, 48.0, and 56.0 MeV. Angular distributions for the prominent transitions are presented. The results are discussed in a semiclassical model, and are analyzed by finite-range distorted-wave Born-approximation (DWBA) calculations. With two sets of optical-model parameters, fixed for the whole region of nuclei, the extracted relative strengths of the transitions are consistent with those known from (^{3}He,d) reactions. The absolute strengths are found to be sensitive to the specific choice of the parameters used in the DWBA. A reexamination of the data that have been interpreted as indications of two-step processes in the (^{16}O,^{15}N) reaction to final states in ^{51}V leads to the conclusion that there is no evidence for such processes in this case at the incident energy employed. (15 figures, 2 tables) (auth)

16086 STUDY OF THE LOW-LYING STATES OF ^{39}Cl VIA THE REACTION ^{37}Cl(t,pγ)^{39}Cl. Warburton, E. K.; Olness, J. W.; Engelbertink, G. A. P. (Brookhaven National Lab., Upton, NY). Phys. Rev., C; 7: No. 1, 170-176(Jan 1973).

A Ge(Li) detector was used to measure γ-ray transitions in ^{39}Cl via proton−γ coincidence studies in the ^{37}Cl(t,pγ)^{39}Cl reaction at E_t = 3.4 MeV. Measurements were carried out with the proton detector centered at 180° and the γ-ray detector at 90 and 0° to the beam. Excitation energies and γ-ray branching ratios were determined for the first 14 levels of ^{39}Cl. The mean lives of these ^{39}Cl states were deduced from the Doppler-shift attenuations observed in the primary transitions. The excitation energies (in keV) and mean lives (in ps) resulting from these measurements are as follows: 396 (>2.0), 1301 (>3.0), 1695 ($1.1^{+0.4}_{-0.3}$), 1722 (0.44 ± 0.09), 1745 (1.3 ± 0.4), 1786 (>2.0), 2061 (<0.05), 2238 (0.08 ± 0.04), 2424 (>1.8), 2490 (0.10 ± 0.05), 2586 (<0.3), 2835 (>1.8), 3116 (0.21 ± 0.06), and 3534 (<0.2). (4 figures, 4 tables) (auth)

16087 CORE-EXCITED 6^+ STATES IN NICKEL ISOTOPES OBSERVED WITH INELASTIC ELECTRON SCATTERING. Itoh, K.; Oyamada, M.; Torizuka, Y. (Tohoku Univ., Sendai). Phys. Rev., C; 7: No. 1, 458-459(Jan 1973).

Inelastic electron scattering from high-lying 6^+ states in the Ni isotopes was measured. These states are interpreted as core-excited states. (2 figures) (auth)

16088 HIGH-ENERGY STATES IN ^{49}V AND THE DECAY OF ^{49}Cr. Okon, O. B. (State Univ. of New York, Albany); Bakhru, H. Dewanjee, M. K.; Preiss, I. L. Phys. Rev., C; 7: No. 1, 239-242 (Jan 1973).

New high-energy states in ^{49}V at 754, 1021.3, 1141.9, 1514.2, and 1661.6 keV were observed. The relative γ-ray intensity and β-decay branching ratios in the decay of ^{49}Cr were remeasured in the high-resolution Ge(Li) detectors. The results are notably different from previously reported values. The half-life of the 90.7-keV state was measured with the delayed coincidence technique as 0.33 ± 0.02 ns. The spin and parity assignments of some of the levels in ^{49}V are discussed. (5 figures, 1 table) (auth)

16089 STUDIES ON EXCITATION CURVES AND THICK TARGET YIELDS CURVES OF ^{52}Fe, ^{55}Fe, ^{56}Mn, ^{49}Cr, AND ^{48}V FORMED BY BOMBARDMENT OF α PARTICLES ON NATURAL CHROMIUM. Akiha, Fumimasa (Hirosaki Univ., Japan). Nippon Kagaku Kaishi; No. 9, 1664-9(Sep 1972). (In Japanese).

On bombardment of natural chromium with α particles up to 44 MeV, ^{52}Fe, the nuclide intended for this study, and other nuclides were formed and throughly examined. The stacked foils of electrolytically deposited chromium metal were used for bombardment. The excitation curves and thick target yields curves of these nuclides were determined from the results of activity measurements. It was found that ^{52}Fe was mainly formed by (α, 2n) reaction of ^{50}Cr and the excitation curve for this reaction showed a maximum cross section of 1 mb when the energy of α particles was 31 MeV. ^{55}Fe, byproduced nuclide, being not chemically separated from ^{52}Fe, was formed by (α, n) and (α, 2n) reactions of ^{52}Cr and ^{53}Cr, respectively. The maximum cross section was 225 mb when the energy of α particles was 15 MeV. From the thick target yields curves, it was found that the total of ^{52}Fe produced were 3.8 and 8.2 μCi/μAhr but the ratios of activities ^{55}Fe to ^{52}Fe were 11.3 and 6.3% for 30 and 40 MeV of α particles, respectively. The total activities of byproduced nuclides amounted to about 1 mCi/μAhr for the latter case, but these nuclides could easily be separated from ^{52}Fe with quite high yield by the proposed radiochemical method. For the production of ^{52}Fe completely free from ^{55}Fe, it requires to use an enriched ^{50}Cr target, but it has several disadvantages such as high cost and tedious procedure for recovery of ^{50}Cr for reuse. It may be said that as a conclusion α bombardment on natural chromium produced ^{54}Mn with reasonably high yield and was superior to the ^{3}He bombardment on natural chromium. The amounts of ^{54}Mn and ^{52}Mn obtained by this method were six and seven times, respectively, as much as those obtained by ^{3}He method. (auth)

16090 PRODUCTION OF $^{43-48}$Sc BY USING 250 MeV BREMSSTRAHLUNG. Nomura, K. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 3: No. 2, 118-22(Dec 1970). (In Japanese).

Yields in the production of scandium isotopes were measured to study spallation reactions by photons. Targets to be irradiated with bremsstrahlung generated by a 250 MeV electron beam were chromium, ^{55}Mn, natural iron, ^{56}Fe, ^{59}Co, nickel, and copper. Scandium was separated chemically from the irradiated targets. The yield was measured by observing gamma-ray spectra with a Ge(Li) detector. Production of ^{43}Sc, ^{44m}Sc, ^{44g}Sc, ^{46}Sc, ^{47}Sc and ^{48}Sc was confirmed from gamma spectra. The yield was obtained from gamma-ray intensity in comparison with that of monitor material (gold foil). Yield curves for the scandium except that from ^{51}V were of parabolic shape, and it was reasonable to apply a two-step model for the process of the production. Mass number of the scandium for maximum yield point was 45.2. Most probable charge for the mass 45.2 was 20.77. These results were in agreement with the results by Halpern et al. The relation between the yield and atomic number of parent nuclei was obtained, and shown in a figure. The yield decreases with the atomic number of targets. (Japan)

16091 MAGNETIC DIPOLE MOMENT OF ^{55}Co. Callaghan, P. T.; Kaplan, M.; Stone, N. J. (Mullard Cryomagnetic Lab., Oxford). Nucl. Phys.; A201: No. 3, 561-569(1973).

The ground state g-factor for ^{55}Co has been measured as $|g| = 1.378 \pm 0.001$ by the technique of nuclear magnetic resonance on oriented nuclei. The temperature dependence of γ-ray anisotropy in the ^{55}Fe daughter decay determines both the 1408 keV level spin and the ^{55}Co ground state spin to be $^7/_2$, and yields values of mixing ratios in the 1037 keV β-transition and the 477 keV γ-transition. The configuration mixing model is used to discuss $1f_{\frac{7}{2}}$ moment systematics. (auth)

Nuclear Properties and Reactions, 59 ≤ A ≤ 89

Refer also to abstracts 16040, 16041, 16044, 16058, 16078, 16081, 16085, 16087, 16090, 16116, 16120, 16126, 16127, 16168, and 16233.

16092 (IS-T-551) DECAYS OF ^{88}Kr AND ^{88}Rb. Bunting, R. L. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 157p. Dep. NTIS.

Thesis.

Gamma-ray singles and coincidence measurements with large-volume Ge(Li) detectors were made of the gamma-ray de-excitation following the beta decays of ^{88}Kr and ^{88}Rb. The sources were produced at the TRISTAN on-line isotope separator facility. Accurate gamma-ray energies and intensities are reported and energy level schemes constructed for ^{88}Rb and ^{88}Sr. The ^{88}Rb level scheme contains 22 levels, with six new levels added to previous schemes. Of the 99 transitions associated with the ^{88}Kr decay, 80 were placed in the ^{88}Rb level scheme, representing 99.8 percent of the observed gamma-ray intensity. Thirty transitions were assigned to the ^{88}Rb decay and 27 were placed in 14 levels of the ^{88}Sr level scheme. The gamma-gamma coincidence information strongly supports the existing ^{88}Sr level schemes with one notable exception, where definite coincidence between the 1366-keV and 3486-keV

transition was observed. This cascade has been used in previous angular correlation studies to establish the spin of the 4853-keV level in ^{88}Sr as $J^{\pi} = 2^{-}$, accepted in this work. Recent studies fail to observe this transition and assign a value of $J^{\pi} = 1^{-}$ to the 4853-keV level. The beta-decay branching for both decays was determined from equilibrium studies and gamma-ray intensity balances. The excellent agreement of the calculated beta branching from the ^{88}Rb decay with recent direct measurements at this laboratory is noted. (auth)

16093 (IS-T-556) DETERMINATION OF (γ,n) AND (γ,2n) CROSS SECTIONS IN ^{70}Ge, ^{72}Ge, ^{74}Ge, AND ^{76}Ge. Vander Molen, H. J. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 99p. Dep. NTIS.

Thesis.

Cross sections for the (γ,n) and (γ,2n) reactions of ^{70}Ge, ^{72}Ge, ^{74}Ge, and ^{76}Ge were measured from threshold to 40 MeV. One-gram separated-isotope targets of the four nuclides were bombarded with bremsstrahlung from the Iowa State University 70-MeV electron synchrotron. The photoneutrons emitted during bombardment were counted by a high-efficiency 4π neutron-sensitive scintillation detector. The neutron multiplicities were separated by an on-line event-by-event recording system. Reaction yields were obtained at bremsstrahlung endpoint energies between 10 and 40 MeV at 2-MeV intervals, and cross sections were extracted from the resulting yield curves. Resonances were observed at about 17 MeV in the (γ,n) reactions, and at about 26 MeV in the (γ,2n) reaction, for all four nuclides. In addition, a secondary resonance in the (γ,n) reaction was observed at 35 MeV in ^{70}Ge, 34 MeV in ^{72}Ge, 31 MeV in ^{74}Ge, and 25 MeV in ^{76}Ge. These results, along with the (γ,p) and (γ,np) cross sections measured in parallel experiments, will be used to study the systematics of the giant resonance structure of germanium, as a function of neutron excess. (16 figures, 5 tables) (auth)

16094 (JINR-D1-6349, pp 565-73) INVESTIGATION OF NUCLEAR STRUCTURE BY MEANS OF ELECTRON ELASTIC AND INELASTIC SCATTERING. Afanas'ev, N. G. (Physical-Technical Inst., Kharkov); Inopin, E. V.; Luk'yanov, V. K.; Pol, Yu. S. (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The elastic scattering of electrons with energies of 100 to 225 MeV was determined for 22 nuclei: ^{12}C, ^{23}Na, ^{24,26}Mg, ^{28}Si, ^{39}K, ^{54,56,58}Fe, ^{58,60,62,64}Ni, ^{64,66}Zn, ^{93}Yb, ^{112,116,118,124}Sn, and ^{139}La. The charge-density distribution parameters were studied as functions of neutron abundance in the nucleus (for A = 54 to 124). (5 figures) (KSW)

16095 (JINR-P14-6701) EFFECTIVE FIELDS AT Se NUCLEI IN FERROMAGNETIC METALS. Balanda, A.; Krulyas, K.; Khrynkevich, A. Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 9p. (In Russian). Dep. NTIS (U. S. Sales Only).

^{77}Br source is obtained in the crystal lattices of Fe, Co, Ni. The precision frequency of the magnetic moment of the nucleus ^{77}Se in the 248-keV excited state in the effective fields was measured. The effective field value at Se nuclei in Ni was determined, as well as the lower boundaries of fields at Se in Co and Fe. (2 figures) (auth)

16096 MASS OF ^{64}Ge AND ITS ROLE IN NUCLEOSYNTHESIS. Davids, C. N.; Goosman, D. R. (Univ. of Texas, Austin). Phys. Rev., C; 7: No. 1, 122-127(Jan 1973).

The mass of the N = Z nucleus $^{64}_{32}$Ge was measured by determining the positron end-point energy from the prominent decay to the 427-keV state in ^{64}Ga. The ^{54}Fe(^{12}C,2n)^{64}Ge reaction was used to produce ^{64}Ge, at a bombarding energy of 36 MeV. Off-line $\beta^{+}-\gamma$ coincidences were studied, as well as the half-life of the 427-keV transition. The half-life was observed to be 70 ± 7 s, in agreement with a previous measurement. The observed end-point energy was 2.96 ± 0.25 MeV, this value leading to a total decay energy of 4.41 ± 0.25 MeV and a mass excess of −54.43 ± 0.25 MeV for ^{64}Ge. Implications for nucleosynthesis and the solar system abundance of ^{64}Zn are discussed. (5 figures) (auth)

16097 E2-M1 ADMIXTURES OF TRANSITIONS IN ^{68}Zn. Lange, J. (Vanderbilt Univ., Nashville); Hamilton, J. H.; Little, P. E.; (and others). Phys. Rev., C; 7: No. 1, 177-179(Jan 1973).

Directional correlations were carried out with a NaI-Ge(Li) detector arrangement on three $2^{+} \rightarrow 2^{+}$ cascades in ^{68}Zn. The data yield the following δ values: −1.46(14), −0.14(4), and +0.29(5) for the 806-, 1261-, and 1745-keV transitions to the first excited 2^{+} level. The first two results confirm recent values from (n,γ) work but not the earlier ones from radioactivity studies. A new 2822-keV transition was observed from a level at that energy. (1 figure, 2 tables) (auth)

16098 BETA SPECTRUM OF ^{87}Kr. Wohn, F. K.; Halbig, J. K.; Talbert, W. L. Jr.; McConnell, J. R. (Ames Lab., Iowa). Phys. Rev., C; 7: No. 1, 160-165(Jan 1973).

A measurement of the β spectrum of ^{87}Kr was undertaken to resolve some discrepancies in recently reported values of the branching of the β decay to the ground state of ^{87}Rb. Sources of mass-separated ^{87}Kr, provided by the TRISTAN on-line isotope separator, were investigated with a high-resolution $\pi\sqrt{2}$ magnetic spectrometer. By using constraints based on previous γ-ray decay schemes, the measurement yielded a Q value of 3.888 ± 0.007 MeV and a ground-state β intensity of (30.5 ± 2.2)%. In addition, the intensity ratio for an unresolved γ-ray doublet at 2555 keV was independently determined on the basis of β-branch intensities to the levels at 2555 and 2960 keV. (2 figures, 1 table) (auth)

16099 ^{69,71}Ga(d,p) AND ^{71}Ga(d,t) REACTIONS. Yntema, J. L. (Argonne National Lab., IL). Phys. Rev., C; 7: No. 1, 140-149 (Jan 1973).

Angular distributions from the (d,p) reaction on ^{69}Ga and ^{71}Ga were obtained with the 12-MeV deuteron beam of the Argonne tandem van de Graaff. Excitation energies and l-transfer values were obtained for a number of levels below 2 MeV excitation. The ground state of ^{72}Ga is not excited with observable cross section in the ^{71}Ga(d,p)^{72}Ga reaction. The first level excited with an appreciable cross section is the 1^{+} level at 161 keV in ^{72}Ga. The (d,t) reaction on ^{71}Ga proceeds to the ground state of ^{70}Ga and, over the energy range covered, excites most of the levels observed to have a strong l = 1 component in the ^{69}Ga(d,p)^{70}Ga reaction. The excitation of the ground state of ^{70}Ga via neutron pickup from ^{71}Ga suggests that the neutron ground-state wave function of ^{72}Ga has a large $(1g_{9/2})^{3}_{5}+$ component. (10 figures, 5 tables) (auth)

16100 ^{84}Sr(x,x') AND ^{84}Sr(x,x'γ) MEASUREMENTS WITH 13-MeV PROTONS, 12-MeV DEUTERONS, AND 18-MeV α PARTICLES. Rester, A. C. (Delft Univ. of Tech., Netherlands); van Nooijen, B.; Spilling, P.; Konijn, J.; Pinajian, J. J. Phys. Rev., C; 7: No. 1, 210-216(Jan 1973).

Inelastic scattering experiments, using the ^{84}Sr(α,α'), ^{84}Sr(α,α'γ), ^{84}Sr(p,p'), and ^{84}Sr(p,p'γ) reactions, were performed on 82.2% enriched ^{84}Sr targets with solid-state detectors. The 18-MeV α-particle inelastic scattering measurements resulted in the identification of excited states at 0.793, 1.454, 1.767, 2.07, 2.447, 2.62, 2.75, 2.81, 2.87, (3.01), 3.16, 3.24, 3.32, 3.46, 3.52, 3.65, 3.96, 4.25, 4.36, 4.55, 4.66, and 4.74 MeV, whereas the 13-MeV proton measurements resulted in identification of excited states at 0.793, 1.454, (1.502), 1.767, 2.07, 2.447, 2.76, (2.81), 2.88, (3.02), 3.18, (3.24), (3.34), 3.40, (3.48), and (3.53) MeV. Angular distributions of 1 MeV deuterons inelastically scattered from the 0.793- and 2.447-MeV states were measured with an Enge magnetic spectrograph, and were fitted by L = 2 and L = 3 distorted-wave Born-approximation angular-momentum-transfer curves, respectively. Deformation parameters $\beta_2 = 0.150$ and $\beta_3 = 0.129$ were deduced. (5 figures, 2 tables) (auth)

16101 GAMMA-RAY DECAY SCHEMES FOR ^{89}Kr AND ^{89}Rb. Henry, E. A.; Talbert, W. L. Jr.; McConnell, J. R. (Ames Lab., Iowa). Phys. Rev., C; 7: No. 1, 222-238(Jan 1973).

A study of γ-ray deexcitations following the β decays of ^{89}Kr and ^{89}Rb was made. The activities were produced from the TRISTAN on-line isotope-separator system. Measurements of γ-ray energies and intensities were made using Ge(Li) detectors. Level schemes were constructed for ^{89}Rb and ^{89}Sr with the aid of $\gamma-\gamma$ coincidence information, and β branching was determined from equilibrium data and γ-intensity balances. The excited levels of ^{89}Sr appear to be explained by single-particle states and the coupling of single-particle states to the vibration states of ^{88}Sr. The ^{89}Rb nucleus is shown to have a complex level scheme, and will require further studies to clarify the picture of its nuclear structure. (3 figures, 4 tables) (auth)

16102 STUDY OF LEVEL STRUCTURE OF ^{78}Kr. Bakhru, H. (State Univ. of New York, Albany); Landenbauer-Bellis, I. M.; Jones, B. Phys. Rev., C; 7: No. 1, 243-248(Jan 1973).

^{78}Rb and ^{78m}Rb were produced via the following heavy-ion reactions: ^{65}Cu(^{16}O,3n)^{78,78m}Rb and ^{69}Ga(^{12}C,3n)^{78,78m}Rb. The half-lives of ^{78}Rb and ^{78m}Rb were measured and found to be 6.5 ± 0.5 min and 4.2 ± 0.2 min, respectively. The study of singles γ-ray spectra and the use of two large Ge(Li) detectors in coincidence revealed the existence of several previously unreported transitions in ^{78}Kr. Decay schemes are proposed for ^{78}Rb and ^{78m}Rb, populating the following levels in ^{78}Kr: 455.1,

1119.7, 1148.0, 1564.9, and 1978.5 keV. Spin and parity assignments of some of the levels of ^{78}Kr are discussed. (5 figures, 2 tables) (auth)

16103 SPIN AND PARITY OF THE 1771.2 keV EXCITED STATE OF ^{108}Pd. Behar, M. (Purdue Univ., Lafayette, IN); Krane, K. S.; Steffen, R. M.; Bunker, M. E. Nucl. Phys.; A201: No. 1, 126-134(1973).

The spin and parity assignment of the 1771.2-keV level of ^{108}Pd was unambiguously determined to be $I^{\pi} = 6^+$ by a combination of precise $\gamma-\gamma$ directional correlation experiments and by linear-polarization correlation measurements of the γ-rays following the decay of ^{108m}Ag. A planar Ge(Li) detector was used in the linear-polarization observations, and the polarization response of such an analyzer was investigated. Triple directional correlation observations were used to corroborate the $6^+-4^+-2^+-0^+$ spin sequence in the 723-614-434 keV γ-cascade. A careful study of the γ-spectrum emitted in the decay of ^{108m}Ag revealed no indication of the presence of a previously reported 836.5 keV γ-ray. (auth)

16104 STATES OF ^{76}Br OBSERVED IN THE DECAY OF ^{76}Kr. Paradellis, T.; Houdayer, A.; Mark, S. K. (McGill Univ., Montreal). Nucl. Phys.; A201: No. 1, 113-125(1973).

The decay of ^{76}Kr is studied by means of β- and γ-ray spectroscopy. Of the 54 γ-rays observed, 51 of them are placed in a decay scheme which includes excited states at 45.5, 150.5, 252.0, 260.0, 280.0, 315.7, 317.1, 355.3, 446.3, 451.9, 616.0, 815.3, 868.2, 898.5, 936.5 and 1047.8 keV. With the help of internal conversion electron measurements and the deduced log ft values, spin-parity assignments are made for the observed states in ^{76}Br. The ground state of ^{76}Br is established as a 1^- state. (auth)

16105 NUCLEAR RESONANCE FLUORESCENCE WITH BREMSSTRAHLUNG. Arnold, R. G. Boston; Boston Univ. (1972). 297p. University Microfilms Order No. 72-25,238. Thesis.

Nuclear resonant scattering of bremsstrahlung from a 3 MeV Van de Graaff was used to measure transition strengths in stable nuclei. The basic quantity measured in direct scattering experiments is $g\Gamma_0$ (Γ_1/Γ) $W(\theta)$, where Γ is the full width of the excited state, Γ_0 is the partial width for gamma decay to the ground state, $g = (2J_1 + 1)/(2J_0 + 1)$ is the multiplicity of the upward transition, (Γ_1/Γ) is the branching ratio to a lower level, and $W(\theta)$ is the angular distribution of the scattered radiation. The quantity of $g\Gamma_0$ (Γ/Γ) $W(\theta)$ will be referred to as the scattering width. The determination of level widths in direct scattering experiments requires knowledge of the incident flux. In this work the photon flux was determined by measuring the photons resonantly scattered from levels of known and unknown width simultaneously. A survey of resonance fluorescence transitions in nuclei where $g\Gamma_0$ (Γ_1/Γ) $W(\theta)$ is known was made to establish the flux calibration. The nuclei, level energies (keV), and Γ_0 (MeV) derived from these measurements are: ^{63}Cu 670(2.58 ± 0.20), 962(0.816 ± 0.045), ^{65}Cu 769(4.81 ± 0.36), 1115(1.63 ± 0.09), ^{64}Zn 992(0.239 ± 0.017), ^{66}Zn 1039(0.267 ± 0.030), ^{68}Zn 1078(0.323 ± 0.037), ^{59}Co 1190(8.01 ± 0.30), ^{60}Ni 1332(0.550 ± 0.043), ^{58}Ni 1454(0.612 ± 0.043), ^{89}Y 1507(22.3 ± 1.4), ^{55}Mn 1529(7.10 ± 0.54), ^{25}Mg 1614(27.0 ± 1.3), ^{28}Si 1779(0.943 ± 0.075), ^{11}B 2124(113.0 ± 5.0), ^{27}Al 2210(16.28 ± 0.39), 2979(121.5 ± 7.8), ^{32}S 2230(2.68 ± 0.18), ^{31}P 2234(1.45 ± 0.15), ^{23}Na 2981(92.9 ± 8.0), ^{31}P 3135(69.6 ± 3.9). Another set of nuclear levels useful for flux monitors but poorly known in width were also measured. The nuclei, level energies (keV), and resulting $g\Gamma_0$ (MeV) are: ^{19}F 1459(2.44 ± 0.22), 1554(4.22 ± 0.24), ^{35}Cl 3003(43.5 ± 3.6), ^{55}Mn 1884(49.3 ± 7.4), 2197(19.6 ± 1.3), 2250(15.9 ± 0.6), 2363(13.0 ± 1.0), 2563 (56.3 ± 4.0), ^{63}Cu 1326(0.95 ± 0.10). Using the above transitions for flux calibration, resonant scattering studies were conducted in scandium and gallium. Partial widths $g\Gamma_0$ (MeV) for the following levels were obtained from the scattering widths using the branching ratios from the literature and assuming $W(125°) = 1.0$. ^{45}Sc 543(0.029 ± 0.006), 721(1.70 ± 0.16), 974(0.17 ± 0.03), 1237 (0.366 ± 0.020), 1411(1.40 ± 0.13), 1664(3.57± 0.41), 1799(0.86 ± 0.21), 2095(56.5 ± 9.0), 2590(13.9 ± 1.6), ^{69}Ga 574(0.053 ± 0.006), 872(1.55 ± 0.15), 1106(2.7 ± 0.2), 1336(0.70 ± 0.04), 1488(0.22 ± 0.08), 1723(0.55 ± 0.20), 1891(14.1 ± 1.5), 2022(3.1 ± 0.3), 2042 (3.0 ± 1.0), ^{71}Ga 910(0.58 ± 0.05), 965(0.36 ± 0.06), 1109(2.3 ± 0.3), 1395(0.25 ± 0.06), 1720(1.5 ± 0.6), 2065(2.7 ± 0.4). Three previously unknown transitions were observed in gallium and cannot be assigned to a particular isotope. The energies (±2 keV) and scattering widths (MeV), assuming they are ground state transitions, are: for ^{69}Ga 1971.8(1.0 ± 0.2), 2007.5(1.0 ± 0.1), 2105.9 (2.9 ± 0.2) and widths for assignment to ^{71}Ga (1.6 ± 0.3) (1.6 ± 0.2) (4.4 ± 0.3). A comparison was made of the experimental transition probabilities in ^{69}Ga with those calculated with a unified collective model by Paradellis and Hontzeas. By comparing the widths from resonance fluorescence, which are M1, E2, M1 + E2, and occasionally E1, with E2 widths measured in Coulomb excitation, the following mixing ratios $\delta^2 = \Gamma_0(E2)/\Gamma_0(M1)$ were deduced for ground state transitions in ^{45}Sc: 720(0.0057 ± 0.0014), 1237(51+ ∞ −45), 1663(0.25 ± 0.05). (Diss. Abstr. Int., B)

16106 PRE-EQUILIBRIUM PROCESSES IN (p,n) REACTIONS. Birattari, C.; Gadioli, E.; Gadioli Erba, E.; (and others) (Univ., Milan). Nucl. Phys.; A201: No. 3, 579-592(1973).

Cross sections of (p,n) reactions in ^{89}Y, ^{160}Gd and ^{169}Tm have been measured for incident proton energies from 5 to 45 MeV. The contributions to the cross section from compound-nucleus evaporation and from pre-equilibrium neutron emission are evaluated, and found to be in accord with the experimental results of this work, as well as with those previously reported in the literature for target nuclei of $A > 60$. In the equilibration process, the competition between particle emission and internal transition into states with higher exciton number is studied, and the relevant branching ratio is deduced. (auth)

16107 DECAY OF ^{78}Rb AND THE LEVEL SCHEME OF ^{78}K. Nolte, E.; Shida, Y. (Technische Univ., Munich). Z. Phys.; 256: No. 3, 243-52(1972).

The level scheme of ^{78}Kr has been studied with the techniques of γ ray spectroscopy: decay spectra of ^{78}Rb produced by the reactions ^{64}Zn(^{16}O,pn) and ^{65}Cu(^{16}O,3n) have been measured; in-beam $\gamma\gamma$ coincidences have been taken during the irradiation of ^{64}Zn with ^{16}O ions; and an angular distribution measurement of γ rays from the reaction ^{64}Ni(^{16}O,2n)^{78}Kr has been performed. Fifteen excited states in ^{78}Kr have been observed and spins have been proposed for most of these levels. A ^{78}Rb decay with a half-life of 17.5 ± 2 min has been found in addition to the previously known 6.0 ± 0.2 min decay. (auth)

16108 ANGULAR DISTRIBUTIONS OF NEUTRONS PRODUCED IN IRRADIATING Ge, Mo, Ag, Pr TARGETS WITH C, O, Ne, Ar IONS. Il'inov, A. S.; Karamyan, S. A.; Nguyen Tak An; Sharifov, K. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 465-8(Sep 1972). (In Russian).

Angular distributions of neutrons emitted in inelastic interactions of ^{12}C, ^{16}O, ^{22}Ne, ^{40}Ar ions with Ge, Mo, Ag, Pr nuclei have been measured. The results are compared with calculations carried out on the basis of the statistical model of nuclear reactions. It is shown that the main contribution to angular distributions is made by neutrons evaporated from compound nuclei. (auth)

16109 ELASTIC AND INELASTIC SCATTERING OF 104 MeV α-PARTICLES FROM ^{58,60,62,64}Ni. Rebel, H.; Loehken, R.; Schweimer, G. W.; Schatz, G.; Hauser, G. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Phys.; 256: No. 3, 258-90(1972). (In German).

Differential cross sections are measured for the elastic and inelastic scattering of 104 MeV α-particles from ^{58,60,62,64}Ni. The experimental results are analyzed in terms of coupled channels on the basis of an anharmonic vibrational model and proved to be quite sensitive to the values of the deformation parameters. For forward angles the 4^+ angular distributions of ^{58,60}Ni are dominated by an $L = 4$ single excitation mechanism. This is in keeping with the E4-transitions observed in (e,e') scattering. From the 2_1^+- and 3_1^+-results transition rates are derived which can be compared to results of electromagnetic methods and of inelastic proton scattering studies. The comparison indicates that the transition rates differ and are generally higher for the proton scattering. Especially in the case of the 3^- states of ^{58,60}Ni the differences are obvious. The elastic cross sections are analyzed both on the basis of the usual phenomenological model and in terms of a semimicroscopic folding model resulting in values of rms-radii for the nuclear matter distribution. (auth)

16110 LIFETIME MEASUREMENTS IN THE CASE OF UNSEPARABLE ENERGIES OF THE $\gamma-\gamma$-CASCADE. Engel, H.; John, P.; Reuse, B. (Justus-Liebig-Univ., Giessen, Ger.). Z. Naturforsch.; 27a: No. 8-9, 1367-8(1972). (In German).

A method for a relative exact determination of the lifetime of nuclear levels which are populated and depopulated only by a $\gamma-\gamma$-cascade with unseparable energies is presented. The capacity of the method is shown on the examples of the 184 keV level of ^{67}Zn and the 158.6 keV level of ^{117}Sn. (auth)

16111 NEW ISOTOPES ^{73}Zn AND ^{74}Zn. Erdal, B. R. (CERN, Geneva); Westgaard, L.; Zylicz, J.; (and others). Nucl. Phys.; A194: No. 3, 449-57(1972).

The decay characteristics of the new neutron-rich isotopes

^{73}Zn and ^{74}Zn have been investigated using isotopically separated samples produced by the ISOLDE on-line facility. Beta- and γ-ray spectra were recorded, partly in coincidence, by means of a Ge(Li) and a plastic detector. Beta end-point energies have been determined from the Fermi–Kurie plot as well as from a cube-root plot. The Q-values of ^{73}Ga and ^{74}Ga were remeasured to 1.61 ± 0.10 MeV and 5.3 ± 0.2 MeV. The following half-lives and Q-values were assigned to the new Zn isotopes: ^{73}Zn: $T_{½}$ = 23.5 ± 1.0 sec, $Q_β \geq$ 4.7 MeV; ^{74}Zn: $T_{½}$ = 98 ± 2 sec, $Q_β \geq$ 2.1 MeV. (auth)

16112 NEUTRON ACTIVATION RESONANCE INTEGRAL OF ^{74}Ge AND ^{76}Ge AND EVALUATION OF THE ^{74}Ge keV NEUTRON RADIATIVE CAPTURE CROSS SECTION AND RESONANCE INTEGRAL. Ricabarra, M. D.; Turjanski, R.; Ricabarra, G. H. (Comision Nacional de Energie Atomica, Buenos Aires). Can. J. Phys., 50: No. 17, 1978-86(1 Sep 1972).

Values of the reduced activation resonance integral relative to the thermal cross section I'/σ_0 of ^{74}Ge and ^{76}Ge were determined relative to gold by measuring cadmium ratios in a reactor spectrum. A lithium-drifted germanium γ-ray spectrometer was used to resolve the activities of the samples. The results for ^{74}Ge are I'/σ_0 = 1.514 ± 0.031 and I' = 0.681 ± 0.123 b with an assumed σ_0 = 0.45 ± 0.08 b; for ^{76}Ge I'/σ_0 = 12.00 ± 0.16 and I' = 1.992 ± 0.359 with an assumed σ_0 = 0.166 ± 0.030 b. The values obtained for I' are in serious disagreement with the values calculated with neutron resonance parameters and confirm previous results obtained in similar keV average resonance spacing isotopes. Due to this fact a careful evaluation of the keV neutron radiative capture cross section and resonance integral for ^{74}Ge was undertaken. The evaluation and comparison with the experimental value of the resonance integral shows first that for nuclides with an average resonance spacing of keV the unresolved resonance integral was seriously underestimated in many evaluations, and second that between 10 and 100 keV, resonance integrals calculated with smooth low resolution activation cross sections give a better calculation of neutron captures than that obtained with neutron resonance parameters. (auth)

16113 NUCLEAR-STRUCTURE INVESTIGATIONS BY MEANS OF (^{4}He,nγ) AND (p,nγ) PROMPT GAMMA-RAY SPECTROMETRY. Xenoulis, A. C. St. Louis; Washington Univ. (1972). 219p. University Microfilms Order No. 72-24,247.

Thesis.

The level structure of ^{58}Co was investigated via prompt γ-ray energy and intensity measurements utilizing a NaI(Tl)–Ge(Li) anti-Compton spectrometer via the ^{55}Mn(^{4}He,nγ) reaction with ^{4}He^{++} energies in the range 7.5-12.5 MeV. Many of the γ-rays associated with levels in ^{58}Co were identified with the (^{4}He,nγ) reaction by means of n-γ coincidence experiments. Characterization of many levels in ^{58}Co was achieved from γ–γ coincidence relationships established in in-beam γ–γ coincidence measurements. The present γ-ray decay information is used in conjunction with the results of previously reported (^{3}He,d) and (d,α) reactions to make definite $J^π$ assignments to some stripping levels and to place limits for $J^π$ values for several other levels. When the level structure of ^{58}Co is compared with previously reported shell-model calculations, which included configurations of only lowest seniority, qualitative agreement for the first seven states is observed. The level scheme of the ^{95}Tc nucleus has been constructed by means of two methods. First, the β-decay of the 99-min ^{95}Ru to levels of ^{95}Tc was investigated from a radiochemically purified source. The decay scheme was constructed on the evidence of single γ-ray energy and intensity measurements and Ge(Li)–Ge(Li) two-parameter γ–γ coincidence measurements. Secondly, the structure and decay scheme of the same ^{95}Tc nucleus were studied by means of in-beam prompt γ-ray spectroscopy via the ^{95}Mo(p,nγ) nuclear reaction. The reaction spectroscopy supplied information about high-spin states not populated in the radioactive decay of ^{95}Ru. The decay scheme of ^{95}Tc was constructed on the evidence of the following kind of experiments. Single γ-ray energy and intensity measurements; yield of single γ-rays as a function of bombardment energy (excitation function); Ge(Li)–Ge(Li) two-parameter γ–γ coincidence measurements; and liquid-scintillator Ge(Li) n-γ coincidence measurements. Although there is some uncertainty about the spin of a number of low-lying states the over-all experimental evidence obtained in this work was interpreted to favor a core-coupling scheme for the theoretical interpretation of the structure of ^{95}Tc nucleus. Angular distributions of single γ-rays emitted in the ^{61}Ni(p,nγ)^{61}Cu nuclear reaction have been measured in 15° intervals about the beam direction. A PDP-8/L on-line computer was used for the analysis of the experimental data, and the Hauser–Feshbach statistical theory of nuclear reactions was used for the theoretical analysis of the distributions. The experimental conditions under which such measurements may be theoretically analyzed to provide reliable spins and multipole mixing ratios for many transitions in the same nuclide were determined. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 14809, 16040, 16041, 16058, 16065, 16069, 16094, 16108, 16110, 16113, 16154, 16157, 16242, 16261, and 16479.

16114 (AAEC/TM-619) THERMAL CAPTURE CROSS SECTIONS AND RESONANCE INTEGRALS FOR THE AAEC FISSION PRODUCT LIBRARY. Clayton, E. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Sep 1972. 14p. Dep. NTIS (U. S. Sales Only).

Thermal capture cross sections and resonance integrals, which provide a summary of the data available on the AAEC fission product library are tabulated. A brief outline is given of the methods used to adjust the calculated cross sections to recommended experimental values. Order of magnitude estimates for unknown cross sections have been included. (auth)

16115 (INR-P-1418) EMISSION OF FAST LITHIUM FRAGMENTS IN INTERACTIONS OF 25 GeV/c PROTONS WITH Ag AND Br NUCLEI. Sieminska, J.; Soltynski, K. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 18p. Dep. NTIS (U. S. Sales Only).

The production of ^{6}Li and ^{7}Li fragments with E ≳ 10 MeV/nucleon in the interactions of 25-GeV/c protons with heavy emulsion nuclei was investigated. In particular, the influence of the emission of the fast fragment on the emission of the heavy product was analyzed. (auth)

16116 (INS-J-136) PARTICLE AND HOLE SYMMETRY IN NUCLEAR COLLECTIVE EXCITATION OF MEDIUM NUCLEI WITH Z ≈ 50. 1 Oct 1972. 27p. (CONF-720850-1). Dep. NTIS (U. S. Sales Only).

From Symposium on heavy ion reactions; Tokyo, Japan (31 Aug 1972).

Neutron-rich isotopes with 40 ≤ Z ≤ 48 and neutron-deficient isotopes with 52 ≤ Z ≤ 60 treated independently as new quasi-deformed regions were demonstrated to have an intimate relationship. Proton particle orbitals outside and the proton hole orbitals inside of the 50-proton closed shell couple with the neutron core in a symmetrical way to produce a very similar excited level system in the pair isotones with 50 ± z. A simple theoretical consideration shows that it results from the special situation for these nuclear regions where the particle and hole orbitals involved in the nuclear excitation are $g_{9/2}$ and $g_{7/2}$, respectively; that is, $j_p \approx j_h$. This effect was also investigated for the nuclear regions near Z = 82 and 28. It was revealed that it holds nicely in the region near Z = 28, while a strong violation exists in the region near Z = 82. In connection with the discussion of the former region a nuclear structure study of ^{60}Fe with in-beam spectroscopy using the ^{48}Ca(^{18}O, α2n) reaction was reported. (16 figures) (auth)

16117 (JINR-E3-6757) PROGRESS IN THE STUDY OF NUCLEAR STRUCTURE WITH NEUTRONS. Frank, I. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 20p. (CONF-720701-7). Dep. NTIS (U. S. Sales Only).

From International conference on nuclear structure study with neutrons; Budapest, Hungary (31 Jul 1972).

The paper contains the Introductory Talk given at the Conference on Nuclear Structure Studies with Neutrons which was held in Budapest on July 31–August 5, 1972. After a brief historical introduction, the first part of the paper is devoted to the relationship between fundamental problems of neutron physics and its applications. In the second part, the importance of studies using fast neutrons and the necessity of developing experimental techniques are noted. In the third part, the development of nuclear studies by means of resonant neutrons during the period following the 1965 Antwerp Conference is reviewed. In the concluding part, attention is drawn to the impressing variety of the properties of neutron resonances and the possibilities for their study. (auth)

16118 (JINR-P3-6754) ESTIMATE OF PROBABILITIES OF γ-TRANSITIONS BETWEEN HIGHLY EXCITED STATES FROM THE REACTION ^{142}Nd(n,γα)^{140}Ce. Vinivarter, V. I.; Nedvedyuk, K.; Popov, Yu. P.; Rumi, R. F.; Salatskii, V. I.; Tishin, V. G.; Furman, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The α spectra from the reactions ^{143}Nd(n,α) and ^{143}Nd(n,$\gamma\alpha$) at the 55.3-eV resonance were measured. The analysis of these data gave experimental estimates of the hindrance factors for γ-transitions between the highly excited states. It was observed that the main contribution to the reaction ^{143}Nd(n,$\gamma\alpha$) is due to γ-transitions of M1-multipole order. (auth)

16119 (NP-19483) ANNUAL REPORT, 1971. (Tokyo Univ. (Japan). Inst. for Nuclear Study). 163p. Dep. NTIS (U. S. Sales Only).

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16120 (TID-26215(Vol.1)) CINDA 72. VOL. 1. Z ≤ 52. AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. (Technical Information Center (AEC), Oak Ridge, Tenn. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut. ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Jun 1972. 781p.

16121 MAGNETIC MOMENT OF THE 80-keV 1^- STATE OF ^{144}Pr. Sinha, B. K.; Bhattacharyya, R. (Saha Inst. of Nuclear Physics, Calcutta). Phys. Rev., C; 7: No. 1, 350-353(Jan 1973).

The magnetic moment of the 80-keV 1^- state of ^{144}Pr was determined using the integral-reversed-field method of the perturbed angular correlations. The value of $\mu = (-4.3 \pm 1.4)\mu_N$ indicates a structure of the 80-keV level based on the mixing between two shell-model states, both having the odd neutron in $f_{\frac{5}{2}}$ configuration—the odd proton occupying $g_{\frac{7}{2}}$ and $d_{\frac{5}{2}}$ configurations, respectively. (2 figures, 1 table) (auth)

16122 ODD-EVEN EFFECTS IN PRE-EQUILIBRIUM PROCESSES. Grimes, S. M.; Anderson, J. D.; McClure, J. W.; Pohl, B. A.; Wong, C. (Univ. of California, Livermore). Phys. Rev., C; 7: No. 1, 342-350(Jan 1973).

Neutron spectra produced by the (p,n) reaction at 12 and 14 MeV on targets of ^{112}Cd, ^{113}Cd, ^{114}Cd, and ^{115}In are compared with the predictions of the exciton model for pre-equilibrium reactions. It is concluded that, although the shape of the spectra for even-A targets differs from that for odd-A targets, the differences are not entirely consistent with the analysis of Lee and Griffin for (p,n) reactions on the Sn isotopes. The possible explanations for

deviations from model calculations include effects due to shells, pairing, and angular momentum. (13 figures, 1 table) (auth)

16123 TWO-PHOTON DECAY OF THE 1.76-MeV 0^+ STATE OF ^{90}Zr. Nakayama, Y. (Kyoto Univ.). Phys. Rev., C; 7: No. 1, 322-330(Jan 1973).

Measurements of the probability and the energy distribution for two-photon decay from the 1.76-MeV 0^+ first excited state to the 0^+ ground state of ^{90}Zr were performed using a sum-coincidence technique with an antidetector and large lead shields. This improved experimental technique made it possible to eliminate unfavorable coincident events, which would disturb true events from the two-photon process: The ratio of two-photon decay to the sum of internal-pair decay and internal-conversion decay, $T_{\gamma\gamma}/T_{\pi+e}$, was found to be $(5.1 \pm 2.5) \times 10^{-4}$. This value is larger than the upper limits reported recently by other workers, and not consistent with any values calculated based on existing theories. The energy spectrum of one of two photons was also observed. This spectrum suggests reasonably that two-photon decay takes place as an (E1,E1) transition via giant-dipole-resonance states. A discussion of the theoretical significance of this study is given. (6 figures, 1 table) (auth)

16124 INELASTIC PROTON SCATTERING ANGULAR DISTRIBUTIONS. Degnan, J. H.; Cohen, B. L.; Rao, G. R.; Chan, K. C.; Shabason, L. (Univ. of Pittsburgh). Phys. Rev., C; 7: No. 1, 316-321(Jan 1973).

A new technique for determining inelastic angular distributions, which greatly alleviates the background problem, is described. Application of the technique to (p,p′) reactions with targets ^{122}Sn, ^{119}Sn, and ^{112}Sn is discussed, and the results are compared with results using a more conventional technique. The results are that the differential cross section is forward peaked at all energies for (p,p′) reactions with targets ^{119}Sn and ^{122}Sn, while it is approximately isotropic with the target ^{112}Sn at higher excitation energies of the residual nucleus. The ^{112}Sn result is expected from the previously established predominance of ordinary compound-nucleus processes in that reaction. For ^{119}Sn and ^{122}Sn, in which it was previously presumed that isospin-conserving reactions via $T_>$ states dominate the low-energy portion of the proton spectrum, the results indicate a sizable contribution of direct reactions or of pre-equilibrium reactions with very few collisions. (4 figures) (auth)

16125 DECAY OF 5.9-DAY ^{145}Eu TO LEVELS IN ^{145}Sm. Newman, E. (Oak Ridge National Lab., TN); Toth, K. S.; Williams, I. R. Phys. Rev., C; 7: No. 1, 290-296(Jan 1973).

The level structure of ^{145}Sm was studied by observing the electron-capture decay of 5.9-day ^{145}Eu. The radioactive source was prepared by bombarding ^{144}Sm with protons accelerated in the Oak Ridge isochronous cyclotron. Both singles and $\gamma-\gamma$ coincidence spectra were measured. From these measurements, transition energies were obtained to an accuracy better than previously available; and the following new transitions were assigned to the decay of ^{145}Eu: 519.4, 526.2, 713.9, 910.3, 949.9, ~1625, 2340.8, 2508.1, and 2513.0 keV. Because of decay-energy considerations the latter three transitions establish the existence of new ^{145}Sm levels at 2340.8, 2508.1, and 2513.0 keV. From the coincidence data, levels at 1607.6 ($\frac{1}{2}^-$) and 1843.6 ($\frac{1}{2}$, $\frac{3}{2}^-$) keV were also established; these states apparently correspond to those previously observed in ^{144}Sm(d,p) studies at about 1611 and 1854 keV. A survey of available data for N = 83 isotones (^{137}Xe → ^{147}Gd) indicated a systematic shift in excitation energy for seven rather well-established single-neutron states as their location was traced from nuclide to nuclide. On this basis it was then possible to predict in ^{137}Xe, ^{141}Ce, and ^{147}Gd the approximate excitation energies of some of these so far unreported states. (4 figures, 2 tables) (auth)

16126 NEUTRON-NUCLEUS TOTAL AND INELASTIC CROSS SECTIONS: 900 TO 2600 MeV/c. Schimmerling, W. (Princeton-Pennsylvania Accelerator, NJ); Devlin, T. J.; Johnson, W. W.; Vosburgh, K. G.; Mischke, R. E. Phys. Rev., C; 7: No. 1, 248-262(Jan 1973).

Total cross sections were measured for neutrons on 16 targets: 12 selected elements, muscle-tissue-equivalent plastic, water, shielding concrete, and plastic scintillator. The momenta of the incident neutrons 900 to 2600 MeV/c were determined by time of flight. Overall uncertainties are of the order of 5%. The dependence of the total cross sections on the atomic weight of the targets can be approximated by an A^β law, where β varies with momentum from 0.72 to 0.84. The momentum dependence of the cross sections is found to be similar to that of neutron–proton cross sections. Results and similar analyses are also presented for total inelastic cross sections. (10 figures, 4 tables) (auth)

16127 REACTION MECHANISMS IN (p,p′) REACTIONS EXCITING THE HIGH-ENERGY CONTINUUM. Cohen, B. L.; Rao, G. R.; Degnan, J. H.; Chan, K. C. (Univ. of Pittsburgh). Phys. Rev., C; 7: No. 1, 331-342(Jan 1973).

The reaction mechanism in (p,p′) reactions exciting states above about 3 MeV excitation energy was studied in several nuclei in which ordinary compound-nucleus contributions have been shown to be unimportant. Up to 7 MeV in ^{64}Ni and ^{124}Sn, there is strong structure in the energy spectra of emitted protons which is closely correlated with the structure in (d,d′) reactions; this indicates that direct reactions exciting collective states are the dominant mechanism. Distorted-wave Born-approximation calculations are used to show that there is an additional mechanism contributing low-energy protons. This mechanism is believed to be isospin-conserving reactions via $T_>$ states, but it is shown that the decay of these states cannot be treated with statistical theory in the Sn region. A reason for this is proposed, and supporting evidence is presented. The applicability of pre-equilibrium calculations to (p,p′) reactions is discussed. (17 figures) (auth)

16128 HIGH-LYING 2^+ STATES IN ^{148}Sm OBSERVED IN THE DECAY OF 5^- ^{148}Eu. Toth, K. S.; Newman, E. (Oak Ridge National Lab., TN). Phys. Rev., C; 7: No. 1, 460-463(Jan 1973).

Buss and Smither have recently studied levels in ^{148}Sm by investigating the thermal-capture reaction ^{147}Sm(n,γ). Of the 32 levels that they considered (many of these were proposed as new states), only 18 have been observed in ^{148}Eu decay. This investigation of the ^{148}Eu decay scheme produced strong corroborative evidence for the existence of seven additional states proposed by Buss and Smither. Their energies (in keV) and spin assignments are as follows: 1454.6, 2^+; 1664.2, 2^+; 1903.8, 3^+ or 4^+; 2173.2, 2^+; 2339.4, 2^+ or 3^-; 2390.0, 3^+; and 2570.5, 2^+. The 1454.6-keV level is apparently the second 2^+ level expected from energy-level systematics to be at ~1.4 MeV, but for which no conclusive evidence has been available. (2 figures, 1 table) (auth)

16129 STUDY OF ^{93}Nb LEVELS WITH THE ^{96}Mo(p,α)^{93}Nb REACTION. Park, Y. S.; Jones, H. D.; Bainum, D. E. (Army Ballistic Research Labs., Aberdeen Proving Ground, MD) Phys. Rev., C; 7: No. 1, 445-457(Jan 1973).

Levels of ^{93}Nb were studied with the ^{96}Mo(p,α) reaction at 15 MeV incident energy. Angular distributions for transitions to a dozen prominent levels below 2 MeV were measured with 30 to 40 keV experimental resolution over $15° \leq \theta_L \leq 150°$, and they were compared with distorted-wave Born-approximation (DWBA) calculations. Angular distributions for p–^{96}Mo and α–^{93}Nb elastic scattering were also measured, and proton and α optical-model potential parameter sets were determined by a search procedure. Of the three sets of α-potential parameters, the one which best reproduced the measured (p,α) angular distributions of known low-lying levels in ^{93}Nb was chosen as the standard set for the rest of the (p,α) calculations. The conventional triton-cluster form factor was used exclusively for the (p,α) DWBA calculations which lead to J^π assignments. A semimicroscopic form factor was used in a few test cases in order to check the sensitivity of calculations to the choice of form factor. Reliable J^π assignments were made for levels below 1.5 MeV based on the j dependence for $l = l(p,\alpha)$ transfers, as well as for higher angular momentum transfers observed in the present work; and they are in excellent agreement with those determined from recent Coulomb-excitation and ^{90}Zr(α,pγ) experiments. Dominant three-nucleon shell-model configurations to which the levels of interest belong were proposed. (7 figures, 2 tables) (auth)

16130 STUDY OF ^{93}Nb BY MEANS OF THE ^{94}Zr(^{3}He,d) REACTION. Medsker, L. R.; Yntema, J. L. (Argonne National Lab., IL). Phys. Rev., C; 7: No. 1, 440-445(Jan 1973).

The ^{94}Zr(^{3}He,d)^{95}Nb reaction was studied with 35.6-MeV ^{3}He particles from the Argonne cyclotron. Experimental angular distributions were compared with distorted-wave Born-approximation calculations to determine l values and spectroscopic factors. The results are compared with the previous data on (^{3}He,d) and (d,^{3}He) reactions and β decay. The proton configurations of ^{93}Nb are discussed in terms of these data and recent theoretical results. (5 figures, 2 tables) (auth)

16131 STUDY OF HOLE-STATE ANALOGS IN Mo ISOTOPES. Kozub, R. L.; Youngblood, D. H. (Texas A and M Univ., College Station). Phys. Rev., C; 7: No. 1, 410-419(Jan 1973).

A study of isobaric-analog states (IAS) excited in the (p,d) and (d,t) reactions on $^{92,94-96}$Mo, the (^{3}He,α) reaction on ^{92,96}Mo, and the ^{96}Mo(p,d)^{97}Mo reaction is reported. Coulomb energies and angular distributions were measured for analogs of all parent states observed in a (d,^{3}He) study on Mo targets, and some additional nu-

clear structure information was obtained. Distorted-wave Born-approximation calculations were performed, and the resulting spectroscopic factors reveal a pronounced decrease in l = 1 hole strength with increasing mass number as well as fluctuations in the ratios $C^2S_n(p,d)/C^2S_n(d,t)$. The first effect is discussed in terms of mixing with the dense spectrum of $T_<$ levels in the IAS region. (12 figures, 2 tables) (auth)

16132 DIRECTIONAL CORRELATION OF THE GAMMA TRANSITIONS IN ^{140}Ce. Saxena, R. N.; Sharma, H. D. (Univ. of Waterloo, Ont.). Phys. Rev., C; 7: No. 1, 395-403(Jan 1973).

The directional correlations of coincident γ transitions in ^{140}Ce were investigated using a Ge(Li)-NaI(Tl) spectrometer. $\gamma\gamma$ coincidences of the cascades 329-1597, 432-487, 329-487, 432-1597, 487-1597, 751-1597, 815-1597, 867-1597, 919-1597, and 925-1597 were accumulated at 14 different angular positions by using an on-line IBM 360/44 computer. The multipole mixing ratios δ obtained from the correlations are $\delta(328) = -0.4 \pm 0.02$, $\delta(432) = -0.8 \pm 0.1$, $\delta(487) = 0.0 \pm 0.01$, $\delta(751) = 0.30 \pm {}^{0.07}_{0.06}$, $\delta(815) = -0.04 \pm 0.01$, $\delta(867) = 0.25 \pm 0.02$, $\delta(919) = 0.06 \pm 0.09$, and $\delta(925) = -0.15 \pm 0.07$. The predicted electron-conversion coefficients were compared with the experimentally measured values, and the spins and parities of the levels were assigned. The spins and parities of levels at 2464 and 2516 keV appear to be 3^- and 4^+. The former level is not predicted from the model of Wildenthal. (4 figures, 4 tables) (auth)

16133 INELASTIC PROTON SCATTERING FROM ^{96}Mo THROUGH ISOBARIC ANALOG RESONANCES. Kent, J. J.; Coker, W. R.; Moore, C. F. (Univ. of Texas, Austin). Phys. Rev., C; 7: No. 1, 388-394(Jan 1973).

Excitation functions for proton elastic and inelastic scattering to several low-lying states of ^{96}Mo were measured in the energy range from 5.2 to 8.0 MeV. Isobaric analog resonances were used to deduce the structure of parent states in ^{97}Mo. In particular, the ground state of ^{97}Mo was found to have parentage in four excited states of ^{96}Mo, besides the ^{96}Mo ground-state component already known from ^{96}Mo(d,p) studies. Angular distributions were measured on the prominent resonances to determine the angular momenta of the exiting protons and to obtain inelastic partial widths. Noticeable asymmetries in the inelastic yield curves were found and interpreted as arising from interference between the resonance reaction and other (direct) processes. The assignment of spin-parity 0^+ to the 1.15-MeV state of ^{96}Mo is found to be consistent with the present data. (4 figures, 3 tables) (auth)

16134 LEVELS OF ^{138}Cs FED IN THE β-DECAY OF ^{138}Xe. Achterberg, E.; Iglesias, F. C.; Jech, A. E.; (and others) (Comision Nacional de Energia Atomica, Buenos Aires). Phys. Rev., C; 7: No. 1, 365-373(Jan 1973).

The energy levels of ^{138}Cs populated in the decay of 14.2-min ^{138}Xe were investigated using on-line techniques. The γ-ray energies and intensities in the range 0.1 to 2.5 MeV were determined with Ge(Li) detectors. By using a Si(Li) x-ray detector, a 10.7-keV γ ray was found; and its L-shell conversion coefficient, determined to be 150 ± 70. Conversion-electron lines were measured with a Si(Li) detector, and the following K conversion coefficients were calculated (transition energies in keV, within brackets): $(290 \pm 30) \times 10^{-3}$ [154.0], $(62 \pm 14) \times 10^{-3}$ [242.8], $(56 \pm 5) \times 10^{-3}$ [258.5], $(16 \pm 3) \times 10^{-3}$ [396.7], $(37 \pm 8) \times 10^{-3}$ [401.5], and $(15 \pm 2) \times 10^{-3}$ [434.6]. Ge(Li)-Ge(Li) and Si(Li)-Ge(Li) γ-γ coincidences were measured. From these experiments the following level sequence is proposed (energies in keV, J^π within brackets): 0 [$3^{(-)}$]; 10.79 ± 0.11 [$2^{(-)}$]; 15.71 ± 0.12 [$1^{(-)}$, $0^{(-)}$, $2^{(-)}$]; 258.49 ± 0.11 [$2^{(-)}$, $1^{(-)}$]; 412.45 ± 0.16 [$1^{(-)}$]; 450.33 ± 0.16 [$0^{(-)}$, $1^{(-)}$]; 541.05 ± 0.13; 815.7 ± 0.4; 876.21 ± 0.22; 912.62 ± 0.14 [$1^{(-)}$, $2^{(-)}$]; 951.6 ± 0.4; 1109.67 ± 0.17; 1127.0 ± 0.3 [$0^\pm$, $1^\pm$, 2^-]; 1367.5 ± 0.3; 1395.8 ± 0.4; 1489.0 ± 0.4; 2026.67 ± 0.17 [1^+]; 2263.01 ± 0.23 [1^+]; 2337.62 ± 0.19 [1^+]; 2468.5 ± 0.5 [0, 1]; and 2509.00 ± 0.24 [1^+]. (6 figures, 3 tables) (auth)

16135 STRUCTURE OF ^{91}Mo VIA THE (p,d) AND (d,t) REACTIONS. Kozub, R. L.; Youngblood, D. H. (Texas A and M Univ., College Station). Phys. Rev., C; 7: No. 1, 404-410(Jan 1973).

The (p,d) and d,t) reactions on ^{92}Mo were studied at bombarding energies of 38.6 and 40.6 MeV, respectively. The (p,d) reaction Q value was measured to be -10.446 ± 0.015 MeV. Excitation energies and angular distributions were measured for levels up to 3.5 MeV excitation. The distorted-wave Born-approximation spectroscopic factors indicate that essentially all of the $1g_{9/2}$ and $2p_{1/2}$ strength and 60 to 65% of the $2p_{3/2}$ and $1f_{5/2}$ strength were observed. The results are generally in good agreement with the unified-model calculations of Kitching. (auth)

16136 HOLE-VIBRATION STATES IN ^{115}In. Covello, A. (Univ., Naples); Manfredi, V. R.; Azziz, N. Nucl. Phys.; A201: No. 1, 215-224(1973).

The hole-vibration coupling in the Z = 50 region is investigated by calculating the level structure of ^{115}In. Four proton-hole states are coupled with quadrupole and octupole core vibrations. The phonon energies and the amplitudes of the vibrational motions are taken from experiment, while the single-hole energies are treated as free parameters. Most of the observed features of a quintet of states with $I^\pi = 5/2^+, 7/2^+, 9/2^+, 11/2^+, 13/2^+$, which have enhanced E2 transition strengths to the ground state, are well reproduced by the theory. The hole-vibration coupling produces a strong fragmentation of the single-hole strengths. This is quite in agreement with the results of (d,^{3}He) experiments in ^{116}Sn. (auth)

16137 ENERGY LEVELS IN ^{142}Nd. Raman, S. (Oak Ridge National Lab., TN); Foster, J. L. Jr.; Dietzsch, O.; (and others). Nucl. Phys.; A201: No. 1, 21-40(1973).

The excited states of ^{142}Nd were studied by means of the decay of 40 sec ^{142}Pm and the ^{142}Nd(p,p') reaction via isobaric analog resonances. Approximately sixty levels of ^{142}Nd were observed below 5.3 MeV excitation, including several neutron particle-hole states excited strongly in (p,p') at $f_{7/2}$, $p_{3/2}$, $p_{1/2}$ and $f_{5/2}$ analog resonances. All known energy levels in ^{142}Nd were collected together and J^π assignments were proposed for 22 excited states. Also the experimental level spectrum (positive-parity states only) was compared with a calculated one based on the shell model. (auth)

16138 FAST-NEUTRON CROSS SECTIONS OF THE EVEN ISOTOPES OF MOLYBDENUM. Lambropoulos, P.; Guenther, P.; Smith, A.; Whalen, J. (Argonne National Lab., IL). Nucl. Phys.; A201: No. 1, 1-20(1973).

The neutron total and scattering cross sections of ^{92}Mo, ^{94}Mo, ^{96}Mo, ^{98}Mo and ^{100}Mo were experimentally determined. Total neutron cross sections were measured from 0.1 to 1.5 MeV. Neutron elastic and inelastic scattering cross sections were measured from 0.3 to 1.5 MeV. The excitation of states in ^{94}Mo at 879 ± 10 keV, in ^{96}Mo at 786 ± 10 and 1161 ± 20 keV, in ^{98}Mo at 743 ± 10 and 795 ± 10 keV, and in ^{100}Mo at 520 ± 20, 700 ± 10, 1070 ± 20 and 1147 ± 20 keV was observed. The experimental results were interpreted in the context of the optical-statistical model concepts inclusive of resonance width fluctuation, direct excitation, and isotopic-dependent potential effects and statistically assayed for evidence of intermediate resonance structure. (auth)

16139 IDENTIFICATION AND CHARACTERIZATION OF ISOMERIC STATES IN THE DE-EXCITATION OF ^{252}Cf FISSION FRAGMENTS. Clark, R. G. Ames, Iowa; Iowa State Univ. (1972). 148p. University Microfilms Order No. 72-26,911. Thesis.

Isomeric levels, formed before beta decay during the deexcitation of ^{252}Cf fission fragments, have been studied by measuring the K x rays and gamma rays from the isomeric decay. A six-parameter experiment used high-resolution Si(Li) and Ge(Li) detectors to measure photon energies from 10-1500 keV and emission times from 1-3000 nsec after the detection of complementary fission-fragment pairs by Si-Au surface-barrier detectors. A four-parameter experiment used two Ge(Li) detectors to measure coincidence between isomeric gamma rays. Gamma-ray energy, mass and half-life determinations are presented for 226 gamma rays observed in the six-parameter experiment, and these results were combined with results of the four-parameter experiment, K x rays observed in the six parameter work, and previous work to assign 129 of the transitions to specific nuclei. The nature of previously observed intensity peaks at masses 98, 108, and 134 are discussed, along with isomeric de-excitation through ground-state rotational bands of nuclei in the rare-earth region. (Diss. Abstr. Int., B)

16140 INTERNAL CONVERSION PROCESS: THRESHOLD AND PURE MULTIPOLE STUDIES WITH IRON-FREE DOUBLE-FOCUSING BETA RAY SPECTROMETERS, AND α_K VALUES IN THE DECAY OF ^{205}Pb. Lacasse, W. M. Nashville; Vanderbilt Univ. (1972). 100p. University Microfilms Order No. 72-26,113. Thesis.

An iron-free, double-focusing beta ray spectrometer has been put into operation. The detector, current regulation and automatic compensation of the earth's field are discussed. The aberrations, transmission and resolution of the instrument were determined. The spectrometer is automatically controlled by an 8K computer; an outline of the program which regulates the instrument is given. Measurements of the M and N shell conversion electrons of the 2.17-keV transition in ^{99m}Tc were carried out in order to test threshold calculations of internal conversion coefficients. The experimental results compare favorably with the theoretical values

of Hager and Seltzer. The conversion electron spectrum of the 43.5-keV E2 transition in ^{234}U was measured. It was found that a discrepancy in the L and M subshell ratios which had been observed in the rare-earth region did not extend systematically to this higher Z nucleus. The N and higher subshell ratios were compared with the recent theoretical calculations of Dragoun et al., and measured values were found to be in excellent agreement with these theoretical calculations. A Si(Li) detector was used to study the internal conversion spectrum of ^{205}Pb in order to determine α_K values for use in the construction of the nuclear level scheme. Spin and parity assignments of 12 levels are discussed. (Diss. Abstr. Int., B)

16141 STUDY OF ANALOG RESONANCES IN ODD ISOTOPES OF ANTIMONY. Arking, R. New Brunswick, N. J.; Rutgers-The State Univ. (1972). 138p. University Microfilms Order No. 72-27,527.

Thesis.

Differential cross sections and analyzing powers were measured at several angles for protons incident on ^{124}Sn and ^{122}Sn at laboratory energies between 7.2 MeV and 12.0 MeV and on ^{120}Sn between 9.6 MeV and 11.5 MeV. The resonances observed in this energy region correspond to states in ^{125}Sn, ^{123}Sn, and ^{121}Sn below 4 MeV excitation. The orbital angular momentum, resonance energy, full width and partial width of each resonance were extracted from the cross-section excitation functions using a multi-level Breit-Wigner formula plus optical model background. The total angular momentum of each resonance was determined from the analyzing-power excitation functions. Background parameters were determined by optical model analyses of off-resonance angular distributions measured at several energies. The present results are in good agreement with the results of (d,p) experiments with a few notable exceptions. One of these exceptions is the identification of $\frac{1}{2}^-$ states in ^{125}Sn and ^{123}Sn. Spectroscopic factors were calculated using the formalism of R-matrix theory. The agreement with (d,p) spectroscopic factors is only good to within a factor of two. This is due to large sensitivities of the spectroscopic factor to optical model parameters, to large uncertainties in extracting some partial widths, and to large uncertainties in the (d,p) spectroscopic factors. Cross sections for the decay of the first $\frac{1}{2}^-$ resonances in $^{125,123,121}Sb$ to the 2^+ and 3^- collective states in $^{124,122,120}Sn$ were measured. Detailed analysis of the decay of the $\frac{1}{2}^-$ resonance in ^{125}Sb at 10.65 MeV was made using a combination of direct (distorted-wave Born approximation) and Breit-Wigner resonance terms in the collision function. Fits to on- and off-resonance cross-section and analyzing-power angular distributions were good. They yielded spectroscopic information about the parent state in ^{125}Sn, represented as single-particle neutron states coupled to the 0^+ ground state and the 2^+ collective state of ^{124}Sn. The results for the decay of the $\frac{1}{2}^-$ resonance in ^{125}Sb indicate a possibility that this resonance is a doublet with a separation of less than 20 keV. The cross-section excitation function for decay of the first $\frac{1}{2}^-$ resonance in ^{123}Sb also indicates the possibility that this too is a doublet with a separation of approximately 40 keV. The first two $\frac{1}{2}^-$ resonances in ^{121}Sb form a doublet with separations of 80 keV. (Diss. Abstr. Int., B)

16142 SINGLE-CLOSED-SHELL NUCLIDES $^{144}Sm_{82}$ AND $^{146}Gd_{82}$. Kownacki, J. (Research Inst. for Physics, Stockholm); Ryde, H.; Sergeev, V. O.; Sujkowski, Z. Nucl. Phys.; A196: No. 3, 498-528(1972).

Alpha-particle irradiation of enriched ^{142}Nd and ^{144}Sm targets has been used to populate states in the N = 82 nucleides ^{144}Sm and ^{146}Gd. Single γ-ray spectra, angular distributions, $\gamma-\gamma$ coincidence spectra as well as time distributions with respect to the α-beam bursts, have been measured at various bombarding energies. Properties of the levels in the two nucleides are compared. The existence of excited states with the spin sequence $6^+ \rightarrow 4^+ \rightarrow 2^+ \rightarrow 0^+$ is established in both of them, similarly to all the other known N = 82, even-Z isotones. The energy spacing of these states in ^{146}Gd differs from those found in the lighter isotones, which may be attributed to the subshell effect at Z = 64 (filling of both the $g_{\frac{9}{2}}$ and $d_{\frac{5}{2}}$ orbitals). The $6^+ \rightarrow 4^+$ E2 transitions are found to be retarded. The systematic occurrence of the 6^+ isomeric states in all the N = 82 even-Z isotones is discussed. The lowest excited state with negative parity (3^-, 1810 keV) in ^{144}Sm is found to be very strongly populated in the γ-ray cascade following the (α, 2n) reaction. The evidence for the existence of a rather weakly populated low-lying 3^- state in ^{146}Gd (1584 keV) is discussed. A number of higher excited states with excitation energies up to about 5.3 MeV and with spin values up to 10 or 11 are established for both nucleides. In a qualitative discussion, the majority of these states can be explained as primarily two-quasiparticle configurations. Strong population of the highest excited states in both nucleides (at about 5.3 MeV) is noted. This fact is difficult to explain on the basis of simple statistical considerations of the (α, xn) reaction mechanism. (auth)

16143 DECAYS OF ^{114}Sb AND ^{112}Sb. Miyano, K. (Niigata Univ., Japan); Gil, C. J. Phys. Soc. Jap.; 33: No. 6, 1509-14 (Dec 1972).

Decays of ^{114}Sb and ^{112}Sb were investigated with single and coincidence experiments. In the decay of ^{114}Sb, new γ rays at energies of 322 keV (5.5%), 393 keV (1.1%) and 716 keV (3.8%) were found, in addition to the known γ rays at energies of 887 keV (17.7%) and 1300 keV (100%). The highest β-ray end-point energy was obtained to be 4.1 MeV. The half-life of ^{114}Sb was determined to be 200 ± 5 sec. In the decay of ^{112}Sb, γ rays at energies of 992 keV (12.1%) and 1258 keV (100%) were seen. The highest β-ray end-point energy was found to be 5.2 MeV. Decay schemes for ^{114}Sb and ^{112}Sb were proposed. Some properties of the decay schemes may be interpreted in terms of the pairing theory. (auth)

16144 DECAY OF ^{110}Sb. Miyano, K. (Niigata Univ., Japan); Nakahara, H.; Gil, C. J. Phys. Soc. Jap.; 33: No. 6, 1505-8 (Dec 1972).

Decay of ^{110}Sb was studied with a Ge(Li) spectrometer and a β counter. The half-life of ^{110}Sb was determined to be 21.3 ± 1.5 sec. The β rays of 6.5 MeV, 5.6 MeV and 4.8 MeV were found. Fifteen γ rays were assigned to ^{110}Sb. New 12 γ rays were observed. The γ-ray energies and intensities observed are 2456 keV (1.7%), 1426 keV (2.9%), 1244 keV (17.1%), 1212 keV (98.3%), 1027 keV (4.2%), 987 keV (44.1%), 910 keV (14.7%), 829 keV (15.1%), 721 keV (15.4%), 643 keV (2.5%), 638 keV (7.7%), 627 keV (2.5%), 523 keV (1.1%), 440 keV (19.1%) and 180 keV (0.4%). The log ft-values were deduced and a tentative decay scheme of ^{110}Sb was proposed. (auth)

16145 LEVEL OF ^{140}Ce FED BY THE DECAY OF ^{140}Pr. Hayashibe, Shogo; Endo, Yorimasa; Miyata, Takamoto; Shiga, Toshio; Yambe, Masaru (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 3: No. 2, 53-9(Dec 1970). (In Japanese).

The decay of ^{140}Pr was investigated to study the level structure of ^{140}Ce. Sources of the ^{140}Pr were decay products of ^{140}Nd produced by (γ,2n) reactions. Separated isotopes of ^{142}Nd enriched to 97.55% ^{142}Nd were used to produce activity of the ^{140}Nd. The gamma-ray singles spectrum was measured with a Ge(Li) detector and $\gamma-\gamma$ coincidence measurement was performed with a Ge(Li)-NaI coincidence system. The gate of the coincidence measurement was the gamma-ray of 1.596 MeV. Nine energy levels of the gamma-ray including annihilation gamma were observed. Some of them were confirmed from the peaks of the singles spectrum. The energy levels and relative intensity of the gamma-ray are shown in a table. Positron intensity was estimated from the intensity of the observed annihilation gamma. Decay scheme was constructed, and log ft values of beta decay were obtained from the intensity of gamma-ray, beta-ray and E0 transition of 1.896 MeV, and total decay energy. Levels of ^{140}Ce were observed at 1.596, 1.896, 2.350, 2.521, 3.016 and 3.110 MeV, and spins and parities of the levels were 2^+, 0^+, 2^+, (1^+ or 2^+), (0^+) and (1^+ or 2^+), respectively. (Japan)

16146 SOME PECULIARITIES OF INTERACTIONS OF ^{20}Ne AND ^{12}C IONS WITH NUCLEI AT 10 TO 17 MeV/NUCLEON. Nikolaev, V. M.; Shchegolev, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 469-74(Sep 1972). (In Russian).

The excitation functions for the reactions $^{133}Cs(^{20}Ne, 4n)^{149g}Tb$, $^{141}Pr(^{12}C, 4n)^{149g}Tb$, $^{202,204}Hg(^{12}C, 3,5n)^{211}Rn$ have been measured in the ion energy range 50-200 MeV. It has been established that in the high energy region the cross sections are at least 10^3 times higher than the values expected from statistic model. Possible mechanisms which are responsible for the behavior of the excitation functions at high energies are considered for the case of heavy ion interaction with nuclei. (auth)

16147 ABSENCE OF PROTON WEAK COUPLING STATES IN ^{93}Nb. Kent, J. J.; Coker, W. R.; Watson, C. E. (Univ. of Texas, Austin). Z. Phys.; 256: No. 3, 199-209(1972).

The reactions $^{93}Nb(p,p)^{93}Nb$, $^{93}Nb(p,n)^{93}Mo$, and $^{93}Nb(p,p')$ through isobaric analog resonances in ^{94}Mo have been used to study the structure of low-lying ^{93}Nb states, specifically the degree to which these states can be described as single protons coupled to the core states of ^{92}Zr. Excitation curves were obtained from 5.8 to 7.6 MeV incident proton energy, for eight states in ^{93}Nb. Results of this work are compared to results from Coulomb excitation studies, $^{93}Nb(n,n'\gamma)$, $^{93}Nb(d,p)$, $^{92}Zr(^3He,d)$, $^{94}Mo(d,^3He)$ and other related work. (auth)

16148 DETERMINATION OF THE QUADRUPOLE MOMENT OF THE $11/2^-$ EXCITED NUCLEAR STATE OF ^{119}Sn BY MOESSBAUER EXPERIMENTS BELOW 100 mK. Beloserski, G. N.; Gumprecht, D.; Steiner, P. (Freie Univ., Berlin). Phys. Lett.; 42B: No. 3, 349-50(11 Dec 1972).

The quadrupole moment of the $11/2^-$ state of ^{119}Sn has been determined by Moessbauer experiments with sources of $^{119}Sn(OH)_2$ at temperatures between 14 mK and 4.2 K. From the intensity ratios of the two quadrupole lines a value $Q_{11/2} = -0.13 \pm 0.04$ b was obtained. (auth)

16149 SPIN–PARITY ASSIGNMENTS FOR THE EXCITED STATES OF ^{91}Nb FROM THE ^{91}Zr(p,nγ)^{91}Nb REACTION. Matsuki, S.; Nakamura, S.; Hyakutake, M.; (and others) (Kyushu Univ., Fukuoka). Nucl. Phys.; A201: No. 3, 608-620(1973).

The energy levels of ^{91}Nb were studied by means of the (p,nγ) reaction. The de-excitation γ-rays were observed with a Ge(Li) detector in the proton energy range from 3.25 to 5.51 MeV in steps of about 30 keV. Resonances attributed to isobaric analog states in the compound system ^{92}Nb were observed in the excitation functions of the de-excitation γ-rays. From an analysis of these analog resonances, a Hauser–Feshbach analysis and the γ-decay scheme, the spin-parities of the levels up to 2792.6 keV (22 levels) were assigned. (auth)

16150 DECAY OF ^{131}Ba. Singh, R.; Rangacharyulu, C.; Mehta, G. K. (Indian Inst. of Tech., Kanpur). Z. Phys.; 258: No. 1, 12-21(1973).

The decay of ^{131}Ba has been studied by Ge(Li) detector supplemented by Ge(Li)–Ge(Li) fast-slow coincidence and NaI(Tl)–NaI(Tl) sum-coincidence spectrometer. The existence of 31 gamma rays and the levels at 78.8, 123.5, 133.4, 215.7, 373.0, 585.0, 620.0, 696.3, and 1084.4 keV have been confirmed. No evidences are found for the level at 1170 keV and 215.7–78.8 and 696.3–373.0 transitions. Some transitions are found to be connected with the impurities which were attributed to ^{131}Ba decay in earlier studies. The relative intensities and conversion coefficients have been determined and multipolarities of some of the transitions inferred from the comparison of the conversion coefficients with the theoretical values. (auth)

16151 DECAY OF $^{121g+m}$In TO LEVELS IN ^{121}Sn. De Frenne, D.; Jacobs, E. (Institut Interuniversitaire des Sciences Nucleaires, Ghent). Z. Phys.; 258: No. 1, 38-45(1973).

The decay of $^{121g+m}$In to the excited states of ^{121}Sn was produced by the ^{122}Sn(γ,p)^{121}In reaction on an enriched SnO_2 target. Strong indications of the isomeric transition of 321 keV to the ^{121}In ground state were found. In the beta decay of ^{121m}In excited states at 60.1, 908.9, 1101.9, 1120.4, 1403.0, 2864.1, 3119.8, and 3228 keV in ^{121}Sn with J^π values $1/2^+$, $3/2(5/2)^+$, $3/2^+$, $5/2^+$, $5/2^+$, and $1/2^+$ or $3/2^+$ for the three levels around 3 MeV, are fed. In the decay of the ^{121}In ground state only the $7/2^+$ level in ^{121}Sn at 925.3 keV is fed. (auth)

16152 NUCLEAR MOMENT OF THE 23.8 keV STATE AND HYPERFINE ANOMALY IN ^{119}Sn. Crecelius, G. (Freie Univ., Berlin). Z. Phys.; 258: No. 1, 56-63(1973).

Moessbauer effect of the 23.8-keV transition in ^{119}Sn, the nuclear magnetic dipole moment of the 23.8-keV $3/2^+$ state is measured to be 0.632(3) μ_n. From a comparison with previously published results a hyperfine anomaly of −8.8(5)% is obtained. (auth)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 16056, 16073, 16106, 16168, 16172, 16178, 16238, and 16479.

16153 (FRNC-TH-264) ROTATION BANDS OF THE ^{171}Lu, ^{171}Yb, AND ^{177}Ta NUCLEI. Barneoud, D. (Universite Scientifique et Medicale de Grenoble (France)). 1972. 119p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The rotation levels of ^{177}Ta, ^{171}Lu, and ^{171}Yb nuclei were determined from the following reactions: ^{175}Lu(α,2nγ)^{177}Ta, ^{169}Tm(α,2nγ)^{171}Lu, and ^{170}Er(α,3n)^{171}Yb respectively. These reactions enabled the levels to be populated with high spins. The measurements were completed by studies of radioactive disintegration effected by other workers. The experimental results confirm that in the highly deformed nucleus region, the rotor model explains the energies of the observed levels with a high degree of accuracy, in particular if the inertia parameter is assumed to vary linearly with I(I + 1). The perturbations, particularly apparent in the $1/2^-$(541) band of ^{171}Lu and the $7/2^+$(633) band of ^{171}Yb, are explained by the coupling between the core of the nucleus and the independent particle (Coriolis coupling). A comparison between the level schemes for ^{177}Ta and ^{171}Lu demonstrates that the $7/2$(404), $1/2$(541), $9/2$(514), and $5/2$(402) bands appear with these two nuclei, although the respective populations of these bands are very different, and the existence of the $1/2$(411) state was established only for ^{171}Lu. The existence of a three quasiparticle state was only able to be demonstrated for ^{177}La. (France)

16154 (JINR–D1-6349, pp 507-30) WEAK INTERACTIONS OF NUCLEONS. Lobashov, V. M. (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

A search was conducted for nuclear transitions which are absolutely forbidden on account of parity (forbidden alpha-decay). Polarized correlations were examined which violated parity, and arose as a result of interference of the amplitudes of parity conservation and parity nonconservation. The asymmetry of emission of gamma quanta during polarized neutron capture by ^{113}Cd was observed. A comparison was made of the results by various workers on circular polarization of gamma quanta from ^{181}Ta, ^{175}Lu, ^{41}K, and ^{180m}Hf. (3 figures, 4 tables) (KSW)

16155 (JINR–P15-6727) PRODUCTION CROSS SECTIONS OF Po–Pa ISOTOPES IN NUCLEAR REACTIONS WITH ^{31}P AND ^{28}Si IONS. Sun-Tsin-Yan, G. Ya. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The nuclear reactions of the type (^{31}P,4n) and (^{31}P,5n) on the targets of ^{169}Tm, ^{186}W, ^{189}Os, ^{190}Os and ^{192}Os have been studied. The dependences of the production cross sections of the known α-radioactive isotopes ^{195,196}Po, ^{212,213}Ac, ^{215}Th and ^{216}Pa on the bombarding particle energy are presented. (auth)

16156 (ORNL–4847) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH TUNGSTEN FOR INCIDENT NEUTRON ENERGIES BETWEEN 1.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 48p. Dep. NTIS.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with tungsten were obtained for neutron energies between 1.0 and 20 MeV for $\theta_\gamma = 125$ deg. The $d^2\sigma/d\omega dE$ values were obtained using a NaI spectrometer. These data consist of neutron and gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for $0.7 \geq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 160 keV for $E_\gamma \sim 9$ MeV. Neutron energy intervals varied from 0.5 MeV for $E_n = 1$ to 8 MeV to 3 MeV for $E_n = 14$ to 20 MeV. (20 figures) (auth)

16157 (TID–26215(Vol.2)) CINDA 72. VOL. 2. Z ≥ 53. AN INDEX TO THE LITERATURE ON MICROSCOPIC NEUTRON DATA. (Division of Technical Information Extension (AEC), Oak Ridge, Tenn. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut. ENEA Neutron Data Compilation Centre, Gif-sur-Yvette (France). International Atomic Energy Agency, Vienna (Austria). Nuclear Data Section). Jun 1972. 731p.

16158 REEVALUATION OF RATIOS OF E2 TRANSITION PROBABILITIES IN SOME EVEN–EVEN ROTATIONAL NUCLEI. Dar, Y.; Kochan, S.; Tserruya, I. (Technion-Israel Inst. of Tech., Haifa). Phys. Rev., C; 7: No. 1, 472-474(Jan 1973).

The ratio B(E2; 4 → 2)/B(E2; 2 → 0) was calculated for even–even rotational ($152 \leq A \leq 188$) nuclei from lifetime and Coulomb excitation data. Better agreement with theory is achieved when modern data, free from hyperfine interaction effects, are considered. (1 figure, 1 table) (auth)

16159 PARITY MIXING AND THE NUCLEAR STRUCTURE OF ^{183,184}W AND NUCLEAR SPIN–LATTICE RELAXATION FOLLOWING THE DECAYS OF ORIENTED ^{183,184g,184m}Re. Krane, K. S.; Olsen, C. E.; Steyert, W. A. (Los Alamos Scientific Lab., NM). Phys. Rev., C; 7: No. 1, 263-275(Jan 1973).

A small, but nonvanishing, parity impurity was determined in the 1285-keV 5^- level of ^{184}W from observation of the forward–backward asymmetry of the strongly hindered 922-keV E1 γ ray from low-temperature polarized ^{184m}Re. This result was interpreted in terms of admixing by the weak interaction of a nearby opposite-parity level, from estimates of the appropriate transition probabilities. Observations of the 0–90° anisotropies of the angular distribution of γ rays from oriented ^{183,184g,184m}Re yielded values for a number of ^{183,184}W mixing ratios; in particular, E3/E1 mixing was observed in the 922- and 538-keV γ rays. The ^{183,184g,184m}Re magnetic moments and the corresponding spin–lattice relaxation times of Re in Fe were determined. (5 figures, 7 tables) (auth)

16160 STUDY OF HIGH-LYING STATES IN ^{179}Hf AND ^{183,184}W WITH THE (n,γ) REACTION. Casten, R. F.; Kane, W. R. (Brookhaven National Lab., Upton, NY). Phys. Rev., C; 7: No. 1, 419-440(Jan 1973).

The nuclei ^{179}Hf, ^{183,184}W were studied with the (n,γ) reaction for neutrons of several resonant energies. High- and low-energy γ radiation following resonant capture was observed with Ge(Li) detectors. Level schemes were constructed from these data in conjunction with previous information from charged-particle reactions and decay studies. Some discrepancies among previous studies were clarified; and a large number of spin assignments, suggested. From these and data from the (d,p) reaction an analysis is made of the fractionation and distribution of the single-particle Nilsson strength in the energy region 1.3 to 2.3 MeV. It is found that the Nilsson model breaks down rather suddenly above the vibrational energy: a much larger than expected number of rotational bands are observed and the (d,p) strength is severely fragmented. This mixing appears to be larger in ^{183}W than in ^{179}Hf and still larger in ^{184}W. The data for 2^+ and 1^+ states in ^{184}W are compared with recent random-phase-approximation calculations: again, much more configuration mixing is observed than is calculated, and significant (d,p) strength occurs lower than predicted in the spectrum. (7 figures, 9 tables) (auth)

16161 CONVERSION ELECTRON AND γ-RAY SPECTRA FROM THERMAL NEUTRON CAPTURE IN ^{157}Gd. Berzin, Ya. Ya.; Kruminya, A. E.; Neiburg, L. A.; Prokof'ev, P. T. (Inst. of Physics, Riga). Latv. PSR Zinat. Akad. Vestis, Fiz. Teh. Zinat. Ser.; No. 5, 3-7(1972). (In Russian).

The conversion electron spectrum from thermal neutron capture in ^{157}Gd has been measured using a β-spectrograph at a resolution of 0.1% to 0.2%. 140 γ-transitions have been obtained in the energy range from 680 to 1470 keV. Multipolarities have been determined for the most part of the transitions. (auth)

16162 LOW ENERGY GAMMA RAYS IN THE DECAY OF ^{152}Eu (12.4-y). Dasmahapatra, B. (Saha Inst. of Nuclear Physics, Calcutta). Radiochem. Radioanal. Lett.; 12: No. 2-3, 185-90(29 Nov 1972).

Low energy γ-rays emitted in the decay of ^{152}Eu (12.4 y) were investigated with a high resolution Ge(Li) X-ray detector. For the first time the intensities of the ^{152}Gd K-X-rays were measured. The branching ratio—$(EC + \beta^+)/\beta^-$ and the total capture ratio—$P_{L+M+} \ldots/P_K$ in the decay were determined. (auth)

16163 LIFE-TIME OF THE EXCITED COMPOUND NUCLEI IN THE RANGE 79 < Z < 89 MEASURED WITH THE SHADOW EFFECT. Kamanin, V. V.; Karamyan, S. A.; Normuratov, F.; Tret'yakova, S. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 447-52(Sep 1972). (In Russian).

The lifetime of the excited compound nuclei, produced when irradiating monocrystalline targets of ^{186}W and ^{181}Ta by ^{11}B, ^{12}C, ^{16}O, ^{22}Ne, ^{31}P ions of different energies has been measured with the help of the shadow effect. The lifetime values vary within $(2 \text{ to } 7) \cdot 10^{-18}$ sec. Results are compared with calculations made in the assumption of the Fermi-gas statistical model and a model with a constant temperature. (auth)

16164 DE-EXCITATION OF EVEN–ODD NUCLEI OVER THE RANGE 91 ≤ N ≤ 113 AFTER CAPTURING THERMAL NEUTRONS. Groshev, L. V.; Demidov, A. M.; Sokolovskii, L. L. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 16: No. 3, 441-6(Sep 1972). (In Russian).

The peculiarities of the decay of a capturing state for even–odd nuclei with the number of neutrons from 91 up to 113 are discussed. It is noted that probability of E1-transition from a capturing state depends on characteristics of the Nilsson orbit of the final state as well as on "particlicity" and "holicity" of this state. The maxima of integral intensity of high energy part of the spectrum have been found for the range of atomic weights 165 and 185. (auth)

16165 LIFETIME OF THE SECOND EXCITED STATE IN ^{157}Gd. Dar, Y. (Centre de Recherches Nucleaires, Strasbourg); Gerber, J.; Macher, A.; Vivien, J. P. Z. Phys.; 256: No. 3, 253-7(1972).

The mean life of the 131.5 keV, $\frac{7}{2}^-$ state in ^{157}Gd was measured using a modified version of the microwave method. The result obtained is $\tau = 137 \pm 7$ ps. The deduced magnetic parameters g_K, g_R are discussed and compared with theory. (auth)

16166 HALF-LIFE OF ^{165}Dy. Haccoun, A. (Negev Inst. for Arid Zone Research, Beer Sheva, Israel); Preiss, K.; Shani, G. Nucl. Technol.; 17: No. 3, 280-281(Mar 1973).

Using the weighted least squares fit of the curve count rate versus time, we have measured the half-life of ^{165}Dy and found its value to be 140.02 ± 0.36 min. This value was checked by measurements of thermal neutron flux using a Dy foil, assuming a number of values of $T_{\frac{1}{2}}$ clustered around the previously determined value. (auth)

Nuclear Properties and Reactions, 190 ≤ A ≤ 219

Refer also to abstracts 14952, 15463, 16049, 16065, 16116, 16126, 16127, 16140, 16146, 16155, 16157, 16233, and 16261.

16167 (AECL–4257) PHYSICS DIVISION PROGRESS REPORT, APRIL 1–JUNE 30, 1972. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Aug 1972. 90p. (PR-P-94). Dep. NTIS (U. S. Sales Only). AECL $2.00.

COMPUTERS—research at Chalk River, April 1 to June 30, 1972

MATHEMATICS—research at Chalk River, April 1 to June 30, 1972

NUCLEAR PHYSICS—research at Chalk River, April 1 to June 30, 1972

SOLID STATE PHYSICS—research at Chalk River, April 1 to June 30, 1972 (WHK)

16168 (JINR–D1-6349, pp 153-63) CASCADE THEORY OF PARTICLE AND NUCLEI INTERACTIONS WITH NUCLEI. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Sobolevskii, N. M.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Difficulties encountered in the statistical treatment of model simulation of intranuclear cascades may be bypassed by using other phenomenological models which more or less approximate the experimental data. The extent of agreement with experiment of calculated inelastic interactions of high-energy particles with nuclei was sought in the cases of ^{12}C and ^{209}Bi. The cross sections for the photoproduction of neutrons (E < 15 MeV) were calculated for ^{27}Al, ^{56}Fe, ^{64}Cu, ^{96}Mo, ^{108}Ag, ^{181}Ta, ^{184}W, and ^{207}Pb. Fission cross sections were calculated for the nuclei ^{197}Au, ^{209}Bi, and ^{238}U. (6 figures) (KSW)

16169 ELECTROMAGNETIC TRANSITION PROBABILITIES BETWEEN THE LOW-LYING STATES OF ^{203}Tl, ^{205}Tl, AND ^{209}Bi. Kratschmer, W.; Klapdor, H. V.; Grosse, E. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nucl. Phys.; A201: No. 1, 179-192(1973).

A high-accuracy investigation of absolute γ-ray yields and angular distributions after Coulomb excitation of ^{203}Tl, ^{205}Tl and ^{209}Bi allowed the determination of B(E2) and B(M1) values in these nuclei. Some of the data obtained are compared with direct lifetime measurements and internal conversion data. The influence of deorientation effects on the results is discussed. A comparison is made between the experimental transition matrix elements and shell-model and core-coupling-model calculations. The "l-forbidden" M1 transitions, which are caused by core-polarization effects, have strengths of $\approx 10^{-3}$ W.u. In ^{209}Bi the strength of the $f_{\frac{9}{2}} \rightarrow h_{\frac{9}{2}}$ E2 transition is equivalent to a surprisingly large proton polarization charge of (2.8 ± 0.2)e. (auth)

16170 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{205}Pb. Ahluwalia, B.; Chasan, B. (Boston Univ.). Nucl. Phys.; A201: No. 1, 107-112(1973).

Gamma–gamma directional correlation measurements in the decay of 15.3 d ^{205}Bi were undertaken employing a Ge(Li) γ-detector in coincidence with an NaI detector. The correlation coefficients were used to study the spin–parity assignments of accessible states in ^{205}Pb, and to obtain mixing ratios of electromagnetic transitions with error limits lower than those obtained from internal conversion results. (auth)

16171 DECAYS OF ^{205}Po AND ^{203}Po. Alpsten, M. (Chalmers Tekniska Hoegskola, Goteborg); Astner, G. Phys. Scr.; 5: No. 1-2, 41-54(1972).

The decays of 1.8 h ^{205}Po and 37 min ^{203}Po have been investigated. γ-rays were recorded in singles and coincidence using Ge(Li) detectors. Conversion electrons were studied using a Si(Li) detector as well as a double-focusing magnetic spectrometer. Many transition multipolarities have been determined from internal conversion coefficients. Fairly complete decay schemes are presented for the two nuclides. Also the half-life of a $\frac{1}{2}^+$ level at 1497 keV in ^{205}Bi was measured to be 7.9 ± 0.7 μsec. (auth) (Sweden)

16172 STUDY ON MEDIUM WEIGHT AND HEAVY NUCLEI BY USING THE (γ,p) REACTION. Shoda, Katsufusa; Saito, Teijiro; Miyase, Haruhisa; Oikawa, Siro; Suzuki, Atuto (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 4: No. 2, 33-41(Feb 1972). (In Japanese).

The (γ,p) reaction was employed to study isobaric analog states. The proton emission mode of ^{208}Pb (γ,p) reaction was studied. The experimental result was explained as decay concerning the p-particle and n-hole state included in an E1 isobaric analog state of ^{208}Pb. Proton partial width for each excited state of the residual nucleus ^{207}Tl was shown in a table. Electron scattering experiments concerning ^{181}Ta and ^{155}Gd were also performed. Differential cross sections were obtained for the electron energy range of 14 ~ 22 MeV. The cross-section curve for ^{181}Ta shows three points of discontinuity. The first and the second points correspond to the isobaric analog states of ^{181}Ta and the third one includes various configurations. A point of discontinuity was seen in the cross-section curve of ^{155}Gd. It was hard to determine the property of the corresponding state. A Coulomb displacement energy was obtained from the first break seen in the curve of ^{181}Ta. A preliminary experiment of the (γ,p) reaction on Ni isotopes was carried out. Precise experiments are in progress. (Japan)

16173 STUDY OF MEDIUM WEIGHT AND HEAVY NUCLEI BY (γ,p) REACTION. Shoda, K.; Sugawara, M.; Saito, T.; Miyase, H.; Suzuki, A. (Tohoku Univ., Sendai). Kakuriken Kenkyu Hokoku; 3: No. 2, 25-33(Dec 1970). (In Japanese).

Highly excited state of ^{208}Pb was investigated by the reaction of ^{208}Pb(γ,p)^{207}Tl. Lead targets were directly irradiated with an electron beam, and the nuclei were excited by the virtual photon process. Emitted proton spectra were measured with a broad range spectrometer for the proton energy range between 7.5 and 19.0 MeV. A proton yield curve was obtained from the observed spectra. Experimental data was analyzed and a curve of photo-proton cross section was obtained as a function of photon energy. The results were compared with theoretical results based on the isobaric analog state concept. A resonance at 25.3 MeV seems to be the analog state corresponding to the $(g_{9/2}-h_{9/2})$ state of ^{208}Tl. The experimental results were also compared with theoretical results by Fallieros et al. States of ^{142}Nd were studied by the (e,e',p) reaction. A yield curve for protons was measured as a function of electron energy. The isobaric analog state (IAS) was observed at the excitation energy of 19.1 and 20.3 MeV. The experiment is still in progress to investigate N-dependence of IAS. (Japan)

16174 YIELDS OF ^{205}Bi, ^{206}Bi, AND ^{207}Bi IN THE IRRADIATION OF LEAD BY PROTONS AND DEUTERONS. Dmitriev, P. P.; Krasnov, N. N.; Molin, G. A.; Panarin, M. V. At. Energ. (USSR); 33: No. 4, 853-4(Oct 1972). (In Russian).

The yields of ^{205}Bi, ^{206}Bi, and ^{207}Bi from the irradiation of Pb were measured as functions of the energies of the bombarding protons or deuterons over the range 9 to 22 MeV. A tabular survey is presented of yields of the three isotopes taken from the literature and representing seven (p,xn) and seven (d,xn) reactions with Pb isotopes. (KSW)

16175 DIRECTIONAL CORRELATION OF L X RAYS AND GAMMA RAYS IN NUCLEAR ELECTRON CAPTURE AND INTERNAL CONVERSION. Rupnik, T. Eugene, OR; Univ. of Oregon (1972). 66p. University Microfilms Order No. 72-28,183.

Thesis.

Some radioactive atoms decay by orbital electron capture to an excited state of the daughter nucleus, which can subsequently emit a γ ray. If the vacancy left by the captured electron is filled through a radiative transition, an x ray is emitted. Can there be a directional correlation between the γ ray and the x ray? A simple quantum-mechanical argument indicates that the L_3 ($2p_{3/2}$) level is the lowest atomic electron state that can lead to an anisotropic x-γ correlation. Capture from the L_3 state occurs to a measurable extent only in certain types of forbidden decay. ^{207}Bi is one nuclide—probably the only easily available one—that is suitable for a study of the x-γ directional correlation. In the decay of this nuclide additional L_3 vacancies are produced by γ-ray internal conversion. Gamma rays in cascade with the converted transition also can contribute to the correlation of γ rays and L x rays. An experiment has been performed with ^{207}Bi to study directional correlations between 570-keV γ rays and all Pb x rays emitted in transitions to the L_3 level. The L x rays were measured with a Si(Li) detector; the γ rays were detected with two NaI(Tl) crystals placed at 90° and 180° or at 180° and 270° with respect to the direction from source to x-ray detector. Gamma rays were detected in coincidence with the Ll + Lα + Lβ portion of the x-ray spectrum. From the normalized coincidence counting rates, the anisotropy was found to be $A = [W(\pi)/W(\pi/2)]-1 = (2 \pm 2) \times 10^{-3}$. A theoretical study of x-γ directional correlations in nuclear electron capture, due to A. Z. Dolginov (Soviet Physics JETP 34(7), 644 (1958)), has been critically reviewed and extended to second-forbidden transitions. Dolginov's formula for the triple angular correlation between x rays emitted in transitions to the L_3 state, γ rays, and initial nuclear spin has been simplified taking account of the fact, now well-established, that β decay proceeds primarily through the V-A interaction. An L_3-x-ray-γ-ray directional correlation expression for odd-A nuclides that decay by 2nd-forbidden nonunique electron capture has been derived in terms of radial integrals, on the basis of the single-particle nuclear shell model. Hence, a theoretical expression for the measurable correlations in ^{207}Bi decay was found. (Diss. Abstr. Int., B)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 14953, 16030, 16049, 16069, 16139, 16140, 16157, 16168, and 16238.

16176 (INR-P-1409) NUCLEAR LEVELS OF ^{228}Th POPULATED IN THE DECAY OF ^{228}Pa. Kurcewicz, W.; Stryczniewicz, K.; Zylicz, J.; Broda, R.; Chojnacki, S.; Walus, W.; Yutlandov, I. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 43p. Dep. NTIS (U. S. Sales Only).

The decay of ^{228}Pa to the levels of ^{228}Th was extensively studied by various techniques. Singles spectra of γ and K x rays were measured with Si(Li) and Ge(Li) detectors. A set of two Ge(Li) detectors was used to study γ–γ and γ–K x ray coincidences. Measurements of γ spectra in coincidence with the selected internal-conversion lines were carried out using a Ge(Li) detector and a six-gap magnetic β spectrometer. Finally, spectra of internal conversion electrons were studied in a β spectrometer, which uses a Si(Li) detector placed together with a system of diaphragms in a homogeneous magnetic field. The decay scheme was constructed, including 39 levels of ^{228}Th. It accounts for 111 of 160 transitions ascribed to the ^{228}Pa activity. The electron-capture decay energy was determined to be 2103^{+16}_{-8} keV. The strength distribution for the electron-capture feeding of the ^{228}Th levels is analyzed in terms of nuclear models. The Coriolis mixing of four octupole bands (K = 0, 1, 2, and 3) is studied in some detail. The coupling matrix elements deduced from the experiment are compared with the results of the microscopic-model calculations. (10 figures, 6 tables) (auth)

16177 (IS-T-543) PHOTOFISSION CROSS SECTIONS OF ^{232}Th AND ^{236}U FROM THRESHOLD TO 8 MeV. Yester, M. V. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 98p. Dep. NTIS.

Thesis.

Measurements of the photofission cross sections of ^{232}Th and ^{236}U for an energy range of 5.0 to 8.0 MeV are reported. The Compton scattering facility at the Ames Laboratory Research Reactor was used for these measurements. Resonance structure at gamma-ray energies of 6.3 and 7.6 MeV is observed in ^{232}Th and at 5.3, 6.0, 6.5, and 7.5 MeV in ^{236}U. The present results are compared with other photofission experiments and particle-induced fission studies. Suggestions for the interpretation of the resonances are given on the basis of Bohr's fission-channel theory and the existence of a double-humped fission barrier. (auth)

16178 (JINR-E7-6838) FUTURE POSSIBILITIES OF PRODUCING SUPERHEAVY ELEMENTS IN FISSION REACTIONS. Flerov, G. N.; Oganesyan, Yu. Ts. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 32p. Dep. NTIS (U. S. Sales Only).

Some possible uses of the fission process to synthesize superheavy elements are considered. The experimental data, obtained using a ^{136}Xe ion beam, show that in the reaction ^{238}U + ^{136}Xe some heavy fragments, up to ^{254}Cf, are formed. On the basis of these data the conclusion is drawn that, in bombardment of ^{238}U targets with ^{136}Xe ions, superheavy elements near the magic numbers Z = 114 and N = 184 can be synthesized, for which theory predicts considerably enhanced stability. The experimental technique is described; the results of the first experiments on the synthesis of superheavy elements using this technique are presented. (7 figures) (auth)

16179 (KFK-1646) PREPARATION AND INVESTIGATION OF SURPLUS PROTON PLUTONIUM ISOTOPES 232 TO 235. Jaeger, U. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Radiochemie). Jul 1972. 44p. (In German). Dep. NTIS (U. S. Sales Only).

The decay of the plutonium isotopes, 232 to 235, was analyzed by γ- and α-spectroscopy. For the isotopes predominantly decaying by electron capture viz., ^{233}Pu and ^{235}Pu, 27 and 15 γ-lines were detected respectively and decay schemes were proposed. The half lifes and the energies of α-radiation from ^{232}Pu and ^{234}Pu were determined. (auth)

16180 KINETIC ENERGY DISTRIBUTIONS IN THE SPONTANEOUS FISSION OF ^{250}Cm AND ^{250}Cf. Hoffman, D. C.; Ford, G. P.; Balagna, J. P. (Los Alamos Scientific Lab., NM). Phys. Rev., C; 7: No. 1, 276-279(Jan 1973).

The kinetic energy distributions of coincident fragments from the spontaneous fission of ^{250}Cm and ^{250}Cf were measured with silicon surface-barrier detectors. From these data, pre-neutron-emission kinetic energy and mass distributions were calculated. The most probable value of the pre-neutron-emission total kinetic energy is 179.8 MeV for ^{250}Cm and 184.3 MeV for ^{250}Cf. The resultant mass-yield curves are typical of asymmetric fission. The results are compared with measurements for other curium and californium isotopes. (5 figures, 2 tables) (auth)

16181 DETAILED STUDY OF ALPHA EMISSION IN ^{252}Cf FISSION. Mehta, G. K.; Poitou, J.; Ribrag, M.; Signarbieux, C. (CEN de Saclay, Gif-sur-Yvette, France). Phys. Rev., C; 7: No. 1, 373-387(Jan 1973).

Long-range α-accompanied fission of ^{252}Cf was investigated in a five-parameter correlation experiment; and the behavior of each component of total energy, including the prompt neutrons from the individual fragments, as well as from the fragment pairs and the prompt-γ emission, was studied and compared with the binary fission. The problem of determining the nucleon contribution by binary fragments to the α-particle formation is discussed. The average energy of the α particle was observed to increase toward the symmetric fission region: this increase is understood in terms of a possible shift of the scission point towards the heavy fragment. The dependence of the average number of total neutrons on the α-particle energy and the dependence of the α-particle energy on the fragment total kinetic energy are not linear; this result is interpreted to yield some qualitative information on the initial energy of the α particle. Several differential correlations are also discussed. (18 figures, 1 table) (auth)

16182 ANGULAR DISTRIBUTION OF ALPHA PARTICLES IN THE SPONTANEOUS FISSION OF ^{252}Cf. Fluss, M. J.; Kaufman, S. B.; Steinberg, E. P.; Wilkins, B. D. (Argonne National Lab., IL). Phys. Rev., C; 7: No. 1, 353-364(Jan 1973).

The long-range α particles released in the spontaneous fission of ^{252}Cf were studied in a four-parameter experiment. The energy and angle of the α particle were measured with a position-sensitive detector, and the energy and mass of one of the coincident fission fragments were determined from time-of-flight measurements. The most probable angle of all α particles with respect to the light fission fragment was found to be 84.3 ± 0.7°, and the width of the distribution was 18.5 ± 1° (full width at half maximum). Correlations of the α-particle energy and angle with fission-fragment mass are discussed in terms of trajectory calculations and compared with previous data. (11 figures, 1 table) (auth)

16183 MEASUREMENTS OF DELAYED FISSION NEUTRON SPECTRA OF ^{235}U, ^{238}U, AND ^{239}Pu WITH PROTON RECOIL PROPORTIONAL COUNTERS. Fieg, G. (Kernforschungszentrum, Karlsruhe, Ger.). J. Nucl. Energy; 26: No. 12, 585-592 (Dec 1972).

The delayed fission neutron spectra of ^{235}U, ^{238}U and ^{239}Pu were measured for different time intervals after fission with proton recoil proportional counters. For these measurements, the spectra of the various time groups were determined. Neutrons of 14 MeV and, for ^{235}U, also thermal neutrons, were used to induce fission. Where published experimental group spectra were available, comparisons with these results were made. (auth)

16184 STUDIES OF MENDELEVIUM ISOTOPES WITH MASS NUMBERS 248 THROUGH 252. Eskola, Pirkko (Univ. of California, Berkeley). Phys. Rev., C; 7: No. 1, 280-289(Jan 1973).

Five isotopes of mendelevium, with mass numbers 248 through 252, were studied by means of α-particle spectroscopy. The isotopes were produced by bombarding ^{241}Am and ^{243}Am targets with ^{12}C and ^{13}C ions accelerated by the Berkeley heavy-ion linear accelerator. The half-lives of the nuclides and the energies of the main α-particle groups, respectively, were observed to be ^{248}Md: 7 ± 3 s, 8.32 ± 0.02 MeV; ^{249}Md: 24 ± 4 s, 8.03 ± 0.02 MeV; ^{250}Md: 52 ± 6 s, 7.75 ± 0.02 MeV; ^{251}Md: 4.0 ± 0.5 min, 7.55 ± 0.02 MeV; ^{252}Md: 2.3 ± 0.8 min, no α decay. The α-particle energies of ^{245}Es, ^{246}Es, and ^{247}Es, produced mainly by (HI, αxn) reactions, were measured to be 7.73 ± 0.02, 7.36 ± 0.03, and 7.31 ± 0.03 MeV, respectively, and the half-life of ^{247}Es was found to be 4.7 ± 0.3 min. Excitation curves for producing the Md isotopes and some other activities are presented. Estimates for the electron-capture branching of the Md isotopes are given. α-decay hindrance factors were calculated using the spin-independent equations of Preston. The α-decay energy systematics of the mendelevium isotopes is discussed. (10 figures, 1 table) (auth)

16185 EXCITED STATES OF LEAD ISOTOPES OF MASS 202, 200, AND 198. Pautrat, M. (Institut de Physique Nucleaire, Orsay, France); Albouy, G.; Lagrange, J. M.; (and others). Nucl. Phys.; A201: No. 3, 469-485(1973). (In French).

The low-lying excited levels of ^{198,200,202}Pb have been studied by observing γ- and β-rays and $\gamma-\gamma$ coincidences in bismuth decay. Decay schemes have been proposed for these nuclei. Half-lives were determined for the 9^-, 7^-, 5^- and 4^+ levels in ^{200}Pb, and for the 5^- level in ^{198}Pb. Microscopic calculations have been made with Gaussian and surface delta interactions to account for level schemes. The results are discussed. (auth)

16186 OBTAINING SPONTANEOUSLY FISSIONING ISOMERS HAVING NANOSECOND LIFETIMES IN REACTIONS WITH α PARTICLES. Gangrskii, Yu. P.; Nguyen Kong Khan; Pulatov, D. D.. At. Energ. (USSR); 33: No. 4, 829-33(Oct 1972). (In Russian).

Targets of thorium, uranium, plutonium and americium isotopes were irradiated by α-particles in an isochronous cyclotron. Spontaneously fissioning isomers of plutonium, curium, and berkelium having lifetimes of $10^{-9}-10^{-7}$ s were obtained. The method of measurement was based on the time-of-flight of recoil nuclei. The obtained results are discussed on the basis of the double-humped fission-barrier model. (auth)

16187 EFFECT OF CHARGE PARITY IN X-RAY SPECTRA OF FISSION PRODUCTS. Aleksandrov, B. M.; Donichkin, A. G.; Solov'ev, S. M.; Eismont, V. P. JETP Lett. (USSR) (Eng. Transl.); 15: No. 11, 462-4(20 Jun 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 15: No. 11, 652-5(5 Jun 1972).

The x-rays from the products of ^{252}Cf spontaneous fission were studied using a semiconductor spectrometer. The spectra contain only the characteristic radiation of products with odd charge. The observed charge parity effect is attributed to internal conversion. (JWR)

16188 STUDY OF DECAY OF ^{231}Ac. Yamamoto, T. (Tohoku Univ., Sendai); Wakabayasi, T.; Takeda, Y.; Itagaki, S.; Konno, O. Kakuriken Kenkyu Hokoku; 4: No. 1, 53-9(Sep 1971). (In Japanese).

Excited states of ^{231}Th were investigated with the decay of ^{231}Ac produced by ^{232}Th(γ,p)^{231}Ac. The ^{231}Ac nuclei were separated from target material by the solvent extraction method with 0.25 MTTA benzene solution and 0.2 MTTA and 0.2 MTBP carbon tetrachloride. Beta-ray and gamma-ray spectra from the ^{231}Ac were measured with a plastic scintillation counter and a Ge(Li) detector, respectively. Decay curves were obtained with a GM counter, and decomposed to three components of 22 hr, 3.3 hr and 50 min. corresponding to ^{231}Th, ^{141}La and ^{231}Ac, respectively. Decay energy of ^{231}Ac to ^{231}Th was estimated to be 2.2 MeV from the observed beta spectrum. Another beta maximum energy was found to be 1.1 MeV. Twenty-five peaks of gamma-rays were observed in the gamma-ray spectrum. A decay scheme is proposed, and discussion concerning level structure is given in comparison with Nilsson model. (Japan)

16189 PROMPT NEUTRON AND GAMMA-RAY YIELDS IN FISSION INDUCED IN ^{239}Pu BY RESONANCE NEUTRONS: EXISTENCE OF THE (n,γf) REACTION. Shackleton, D. (CEN de Saclay, Gif-sur-Yvette, France); Trochon, J.; Frehaut, J.; Le Bars, M. Phys. Lett.; 42B: No. 3, 344-6(11 Dec 1972).

Fluctuations of the fission neutron multiplicity and prompt γ-ray energy have been measured for resonance neutron induced fission of ^{239}Pu below 110 eV. An observed anticorrelation between fluctuations of these two parameters is attributed to the role of the (n,γf) reaction. (auth)

16190 NEUTRON MULTIPLICITY DISTRIBUTIONS IN THE SPONTANEOUS FISSION OF ^{246}Cm, ^{248}Cm, AND ^{252}Cf. Stoughton, R. W.; Halperin, J.; Bemis, C. E.; Schmitt, H. W. (Oak Ridge National Lab., TN). Nucl. Sci. Eng.; 50: No. 2, 169-171(Feb 1973).

The neutron multiplicities P(n) in the spontaneous fission of ^{246}Cm, ^{248}Cm, and ^{252}Cf have been measured in a ^{3}He neutron counter assembly. The efficiency ϵ for detection of a single neutron was measured to be 0.360, based on $\bar{\nu}$ (average number of neutrons per fission) = 3.73 for ^{252}Cf spontaneous fission. Using this value of ϵ and assuming a Gaussian distribution p(ν) for the

emitted neutrons, we fitted our observed P(n), corrected for small background and pile-up effects, to the model by the method of least squares in which the Gaussian width σ_ν and $\bar{\nu}$ were the parameters of fit. Values of $p(\nu)$ were then calculated from the resulting Gaussian function. In the case of ^{252}Cf, our values of $p(\nu)$ agree well with literature values; the $p(\nu)$ values for the curium isotopes have not been measured previously as far as we know. The values of $\bar{\nu}$ for both ^{246}Cm and ^{248}Cm fall on a straight line through existing experimental values for the nuclides ^{242}Cm, ^{244}Cm, and ^{250}Cm in a plot of $\bar{\nu}$ versus mass number; our values were 2.86 ± 0.06 and 3.14 ± 0.06 for ^{246}Cm and ^{248}Cm, respectively. (auth)

16191 INFLUENCE OF EXCITATION ENERGY ON THE DISTRIBUTION OF FISSION FRAGMENTS OF ^{233}U IN MASSES AND KINETIC ENERGIES. Sergachev, A. I.; D'yachenko, N. P.; Kovalev, A. M.; Kuz minov, B. D. (Physical-Technical Inst., Kazan). Yadern. Fiz.; 16: No. 3, 475-83(Sep 1972). (In Russian).

The yields and kinetic energies of fragments from ^{233}U fission by monoenergetic fast neutrons were studied for the energy interval $0 < E_n < 6$ MeV. The results are discussed from the view point of the influence of structure peculiarities of the splitting nucleus and nuclei-fragments on the yields and kinetics energies. On the basis of energy balance the values for the mean number of prompt neutrons have been obtained in ^{233}U fission by fast neutrons. (auth)

16192 MEASURING EXCITATION ENERGY OF SPONTANEOUSLY FISSIONING ISOMER ^{240}Pu, ^{241}Cm, ^{243}Bk IN REACTIONS WITH α-PARTICLES. Vylkov, I.; Vylkov, N.; Gangrskii, Yu. P.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 454-9(Sep 1972). (In Russian).

The excitation functions for (α,2n) reaction, that lead to the rise of spontaneously fissioning isomers ^{240}Pu, ^{241}Cm, ^{243}Bk have been measured. The time-of-flight method for recoil nuclei was used. The fragments were detected with a dielectric detector. On comparing the excitation functions measured with the calculated ones, excitation energies of the aforementioned isomers were determined. The influence of the parameters taken into account when calculating the energy of the state measured is being discussed. (auth)

16193 L-SUBSHELL FLUORESCENCE AND COSTER-KRONIG YIELDS AT Z = 92 AND THE DECAY OF ^{235}Np. McGeorge, J. C. (Georgia Inst. of Tech., Atlanta); Nix, D. W.; Fink, R. W.; Landrum, J. H. Z. Phys.; 255: No. 4, 335-47(1972).

The K and L x-rays emitted in the decay of ^{235}Np have been studied with high resolution Ge(HP) and Si(Li) detectors in coincidence, in order to obtain the L_2 and L_3 subshell fluorescence and Coster-Kronig yields at Z = 92. The results are: $\nu_2 = 0.630 \pm 0.036$, $\omega_2 = 0.560 \pm 0.033$, $f_{23} = 0.147 \pm 0.010$, and $\omega_3 = 0.481 \pm 0.029$. Results for the L_1 subshell were derived from singles spectra, by assuming a value of f_{13} of 0.67, and are: $\nu_1 = 0.54 \pm 0.04$, $\omega_1 = 0.21 \pm 0.04$, and $f_{12} < 0.07$. With the same assumption, the L_1/K electron capture ratio and decay energy Q_{EC} for ^{235}Np were found to be 29.0 ± 3.6 and 123.6 ± 0.7 keV, respectively. Relative L x-ray intensities for Z = 92 also were measured and are compared with the theory of Scofield and with recent diffraction experiments. Electron ejection from the L shell during ^{235}Np decay has been studied by L x-ray–L x-ray coincidences and found to occur with a probability of $(1.3 \pm 1.0) \times 10^{-4}$ per disintegration. (auth)

16194 DEPENDENCE OF THE ASYMMETRY OF ^{237}Np PHOTOFISSION ON THE MAXIMUM ENERGY OF BREMSSTRAHLUNG. Kondrat'ko, M. Ya.; Korinets, V. N.; Petrzhak, K. A. At. Energ. (USSR); 34: No. 1, 52-53(Jan 1973). (In Russian).

The yields of certain products of symmetric and near-symmetric fission of ^{237}Np by bremsstrahlung from a betatron were measured in the interval of 10 to 24 MeV endpoint energies. Certain fragment isotopes were chosen for study: $^{115,117}Cd$ for symmetric fission, and $^{109,112}Pd$ and $^{111,113}Ag$ for near-symmetric fission. Yields of all isotopes were measured with reference to the yield of ^{140}Ba. The relative yields of masses 112, 113, 115, and 117 were equal and rapidly increased with increase in excitation energy of the fissioning nucleus. The yields of ^{109}Pd and ^{111}Ag showed a less steep growth with increasing energy. Somewhat greater asymmetry of ^{237}Np photofission occurred at E_γ = 10 MeV, and less asymmetry at E_γ = 12 to 24 MeV. Irregularities were absent in the region of symmetrical fission of ^{237}Np. A comparison of the reaction ^{237}Np (γ,f) was made with the reaction ^{235}U (γ,f). (1 figure, 1 table) (KSW)

Nuclear Theory

Refer also to abstracts 15465, 15466, 15865, 16035, 16055, and 16485.

16195 (AERE-R–7279) ON THE STATISTICAL DISTRIBUTION OF FINE-STRUCTURE STRENGTH ABOUT A LORENTZIAN LINE-BROADENING PROFILE. Lynn, J. E. (Atomic Energy Research Establishment, Harwell (England)). Oct 1972. 12p. Dep. NTIS (U.S. Sales Only). UK 50 pence.

As is well known, the mixing of a special state through residual interactions into a dense set of neighboring states results in a profile for the strength of the special state in the resulting eigenfunctions that is approximately of Lorentzian character. The result is exact if the dense states are uniformly spaced and the squared matrix elements of the residual interaction between the special state and the others are equal. A more general result allows for the possibility of energy dependence of the matrix elements; the profile is still of Lorentzian form, but contains an energy-dependent half-width, as well as a level shift quantity. The question of statistical scatter of the squared matrix elements about some mean value is discussed here. The mixing coefficients that result in this case are believed to be describable as a statistical distribution of the individual coefficients about some overall profile. Since an analytical proof of this seems difficult, numerical experiments and statistical analysis of the results are used. (1 figure, 2 tables) (RWR)

16196 (ANU-P–555) EXPERIMENTS ON THE SECOND ORDER PROCESSES IN NUCLEAR REACTIONS. Nurzynski, J. (Australian National Univ., Canberra. Dept. of Nuclear Physics). 1972. 23p. Dep. NTIS (U. S. Sales Only).

Nuclear reactions suitable for a study of the second order processes are discussed. Examples dealt with are, in the order of preference, the charge exchange reactions (^3He,t), the double neutron pickup reactions (p,t) on strongly deformed nuclei and the reactions (mainly the inelastic scattering) involving 1p shell nuclei. The projectile energies required in the first two cases are greater than 10 MeV and can be provided by cyclotrons, cyclograaffs or the new generation of tandem accelerators; in the last case the energies should be below about 10 MeV. (auth)

16197 (ANU-P–557) HEAVY ION TRANSFER REACTIONS. Parkinson, D. M. (Australian National Univ., Canberra. Inst. of Advanced Studies). Aug 1972. 45p. Dep. NTIS (U. S. Sales Only).

Elastic scattering and heavy ion transfer reactions are described with reference to a number of experimental results. (Australia)

16198 (BNL-tr-517) DE-EXCITATION OF p LEVELS IN EVEN-ODD NUCLEI WITH $21 \leq A \leq 41$ VIA CASCADE DE-EXCITATION FOLLOWING THE CAPTURE OF THERMAL NEUTRONS. Demidov, A. M.; Jafar, J. D.; Halil, M. A.; Hussein, F. A. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, N. Y.), from Yadern. Fiz.; 16: No. 1, 3-12(1972). 19p. Dep. NTIS.

The single-particle shell model was used to interpret the cascade deexcitation of p levels in even-odd A = 21 through 41 nuclei following thermal neutron capture. (JWR)

16199 (COO–1764-165) THEORY OF OVERLAP FUNCTIONS. I. SINGLE PARTICLE SUM RULES AND CENTRE-OF-MASS CORRECTIONS. Clement, C. F. (Minnesota Univ., Minneapolis. Atomic Energy Research Establishment. Harwell (England)). 1972. 51p. Dep. NTIS.

Mode-independent relations are obtained between the overlap functions defined by projecting onto one another states of nuclei differing by one particle. Exact partial sum rules for spectroscopic factors obtained from one-nucleon transfer reactions on nonzero spin target nuclei are derived, and some applications to experiments on $2_s1/2$ and $1_f7/2$ neutron transfer are considered. A straightforward derivation is given of the 1/A corrections to the sum rules including the correction to the total single particle sum rule of MacFarlane and French. It is shown that the corrections are not negligible for light nuclei, and the ways in which they affect the interpretation of knockout reactions in the 1p shell and transfer reactions on ^{16}O and ^{40}Ca are discussed. (auth)

16200 (COO–2022-18) MULTILEVEL EXPANSION AND ITS APPLICATION TO NEUTRON RESONANCE ANALYSIS. Final Report. Adler, F. T.; Adler, D. B. (Illinois Univ., Urbana. Dept. of Physics). Jul 1972. Contract AT(11-1)-2022-1. 246p. Dep. NTIS.

The research program on the testing of and applications of the multilevel expansion formalism for neutron resonance analysis is summarized. The scope of the research included a correlated analysis of the ^{239}Pu fission, capture, and total cross sections, computer program development, and exploratory work on the usefulness and adaptability of existing programs. (JWR)

16201 (COO-3001-26) EFFECT OF EXCHANGE CURRENTS ON ORBITAL g-FACTORS AND E1 SUM RULE FOR PHOTOABSORPTION. Arima, A.; Brown, G. E.; Hyuga, H.; Ichimura, M. (State Univ. of New York, Stony Brook. Dept. of Physics). 1972. Contract AT(11-1)-3001. 12p. Dep. NTIS.

The relation between the enhancement, κ, in the E1 sum rule and the δg_1 of orbital magnetic moment is reinvestigated. The relation $\kappa = 2\delta g_1$ of Fujita and Hirata is modified to $\kappa' = 2\delta g_1$, where κ' is the enhancement following from V_{eff}. The tensor correlation leads to large $\Delta\kappa = \kappa - \kappa'$ as well as κ and κ'. (1 table) (auth)

16202 (INR-1412) MOMENTS OF INERTIA OF ATOMIC NUCLEI AND THEIR DEPENDENCE ON DEFORMATION. Pomorski, K. R. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 102p. (In Polish). Dep. NTIS (U. S. Sales Only).

Thesis.

The moments of inertia of even nuclei in ($28 < Z < 50$, $50 < N < 82$), ($50 < Z$, $N < 82$) and rare-earth regions are calculated. The values of moments of inertia for theoretically predicted oblate and prolate shapes of deformed nucleus for all investigated nuclei in the first two regions are given. Dependence of moments of inertia on quadrupole, hexadecapole and gamma deformation, parameters of single particle potential, and strengths of the pairing interaction are also discussed. The calculations are based on the cranking model. (auth)

16203 (INR-1413) MOMENTS OF INERTIA AND GYROMAGNETIC FACTORS OF ATOMIC NUCLEI (NUMERICAL PROGRAM). Pomorski, K. R. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 35p. (In Polish). Dep. NTIS (U. S. Sales Only).

Thesis.

The program is written in the language GIER ALGOL-4. Moments of inertia and gyromagnetic factors are calculated for even nuclei according to formulas given by the cranking model. (auth)

16204 (JINR-D-6465) NUCLEAR STRUCTURE LECTURES, ALUSHTA, APRIL 13-28, 1972. Soloviev, V. G. (ed.) (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 525p. (In English and Russian). Dep. NTIS (U. S. Sales Only).

Separate abstracts were prepared for the 19 lectures included in this report. (LTW)

For abstracts of individual papers see: 16205-16223.

16205 (JINR-D-6465, pp 7-45) INTERPOLATION APPROACH TO THE THEORY OF THE NUCLEUS. Baz, A. I. (Inst. of Atomic Energy, Moscow). 1972. (In Russian).

The K-harmonic method, or the method of hyperspherical functions as it is sometimes called, and its application to many-body problems, both discrete and continuous spectra, are discussed. The form of the wave functions for a nucleus, allowing for decay channels, and the generalized equation for one channel are explored. Resonance position and width, the composition of wave functions, and interactions between nuclei are developed. (KSW)

16206 (JINR-D-6465, pp 46-64) HARTREE-FOCK METHOD IN NUCLEAR THEORY. Rybarska, V. (Univ., Wroclaw). 1972. (In Russian).

Three different courses were followed in solving a problem with the Hartree-Fock method. A solution to the Hartree-Fock problem was first obtained with a nonlocal potential. Then calculations which stemmed from local realistic potentials were made with an infinite repulsion at small distances. The equation was solved with the Bethe-Goldstone expansion. Thirdly, the Hartree-Fock calculations proceeded from a phenomenological ("effective") two-particle interaction. (KSW)

16207 (JINR-D-6465, pp 65-76) VOLUME-CONSERVING PAIRING. Balbutsev, E. B. (Joint Inst. for Nuclear Research, Dubna, USSR); Bochnacki, Z. 1972.

A simple model of volume-conserving pairing in nuclei is proposed. The static pairing determined by this method is called volume conserving because it is calculated at a constant volume of the nucleus with the condition of the mean-square radius replacing the pairing self-consistency condition. (LTW)

16208 (JINR-D-6465, pp 77-123) SEMI-MICROSCOPIC APPROACH IN NUCLEAR THEORY. Solov'ev, V. G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

The semi-microscopic description of the structure of complex nuclei (as distinguished from phenomenological and microscopic descriptions) is based on the choice of effective nuclear interaction between nucleons and is divided into two parts: average nuclear field, created by all the nucleons of the nucleus, and the residual interaction, or that portion of the forces not included in the average field. The semi-microscopic approach is here used to treat low-lying nonrotational states, and it is applied to a study of the structure of highly excited states. (KSW)

16209 (JINR-D-6465, pp 124-165) STRUCTURE OF NEUTRON RESONANCES. Chrien, R. E. (Brookhaven National Lab., Upton, NY). 1972.

Certain topics relevant to the structure of neutron resonances are discussed. A summary of experimental techniques for resonance studies via the (n,γ) reaction and the inverse (γ,n) reaction is given. Experiments relating to direct reaction mechanisms, partial width correlations, pygmy resonances, and doorway states are described. (auth)

16210 (JINR-D-6465, pp 166-186) NEUTRON RESONANCES AND THEIR α-DECAY. Popov, Yu. P. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

A study of the alpha-decay phenomena associated with neutron resonances furnished new information on resonance states. The α-decay schemes and excited states were obtained for ^{144}Nd from the reaction ^{143}Nd$(n,\gamma\alpha)^{140}$Ce. The α-decay of resonance states of the ^{148}Sm nucleus and the distribution of α-widths during transition of ^{148}Sm to the ground state were determined. (KSW)

16211 (JINR-D-6465, pp 187-204) MICROSCOPIC THEORY OF NUCLEAR ROTATION. Nadzhakov, E. (Inst. of Physics, Sofia). 1972. (In Russian).

Nuclear rotation and other forms of motion appear together in the lowest states of nuclear rotational bands. This is connected with the finite number of nucleons in a nucleus and has no analogy in macro-mechanics. A theoretical treatment is given the problem of nuclear rotation with the aid of a generalized model. (KSW)

16212 (JINR-D-6465, pp 205-219) NONADIABATIC APPROACH TO ROTATIONAL BANDS IN ODD-MASS NUCLEI. Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

The model of Bohr and Mottelson was used in a description of the rotational motion of odd-mass nuclei. A Hamiltonian of internal motion and the Schroedinger equation, polarization effects, and rotational bands were part of the development. Experimental data and theoretical calculations were compared in the cases of ^{161}Dy, ^{167}Er, ^{165}Ho, ^{155}Gd, and similar rare earths. (KSW)

16213 (JINR-D-6465, pp 220-287) SHAPE EFFECTS ON NUCLEAR SCATTERING AND REACTIONS. Rasmussen, John (Yale Univ., New Haven). 1972.

Scattering by spherical and deformed nuclei is considered. Rotational band energies and recent developments on the interactions of rotations with pairing and shape changes are discussed. (LTW)

16214 (JINR-D-6465, pp 288-317) SELECTED TOPICS ON SPHERICAL VIBRATIONAL NUCLEI. Alaga, G. (Univ., Zagreb). 1972.

Quadrupole moments, new types of selection and intensity rules governing the transition between the states, and quasirotational band structure in vibrational nuclei are considered. (LTW)

16215 (JINR-D-6465, pp 318-331) ISOMERIC FORMS OF ATOMIC NUCLEI. Polikanov, S. M. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

In this discussion of isomeric forms of nuclei, some spontaneously fissioning isomers (^{242}Am and ^{244}Am) and isomeric models were examined. The periods of spontaneous fission isomers of U, Pu, Am, and Cm were investigated as functions of their numbers of neutrons; the most stable were isomers with $N = 147$, in agreement with the calculations of V. M. Strutinsky (1967-8). Also, isomers of isotopes with odd numbers of neutrons possessed large periods of spontaneous fission. A search was made for electromagnetic transitions in the second potential well. (KSW)

16216 (JINR-D-6465, pp 332-348) VIBRATIONAL LEVELS IN DEFORMED NUCLEI. Hamilton, J. H. (Vanderbilt Univ., Nashville). 1972.

The following selected features of vibrational states in deformed nuclei are reviewed: branching ratios from the quadrupole $K^\pi = 0^+$, β and $K^\pi = 2^+$,γ type vibrational levels; noncollective $K^\pi = 0^+$ bands; two-phonon states; and E1/M2/E2 admixtures in transitions from octupole states. (LTW)

16217 (JINR-D-6465, pp 349-364) SYSTEMATICS OF E2-M1-E0 ADMIXTURES. Hamilton, J. H. (Vanderbilt Univ., Nashville). 1972.

E2-M1-E0 mixing ratios are reviewed and tabulated for level transitions in many nuclei. (LTW)

16218 (JINR-D-6465, pp 365-397) NUCLEI FAR OFF THE STABILITY LINE. Hansen, P. G. (CERN, Geneva). 1972.

Some of the more recent developments in the study of medium-

weight and heavy nuclei that are either very neutron deficient or neutron rich are described. Experimental techniques, some recent results on individual nuclear levels, and statistical properties of nuclear levels populated in high-energy β decay, the β strength function, and the process of delayed-particle emission are discussed. (LTW)

16219 (JINR–D–6465, pp 398–432) NUCLEON MOTION IN THE LANE POTENTIAL. Bondorf, J. P. (Niels Bohr Inst., Copenhagen). 1972.

Some important characteristics of single nucleon motion in nuclei are discussed. The coupling of the states of few degrees of freedom to the states of many degrees of freedom is described. This coupling increases with excitation energy and can be described approximately as absorption. Finally, the absorption of the nucleon and the relevant formalism for resonance reactions are discussed. (LTW)

16220 (JINR–D–6465, pp 433–448) CHANNEL COUPLING IN PARTICLE SCATTERING BY NUCLEI. Shul'ts, G. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

Different approaches are summarized which have been used in describing direct elastic and inelastic scattering of particles by nuclei. The latter were assumed to possess low-lying states of a collective nature. The applicability of phenomenological models on this type of investigation is demonstrated. The method of distorted waves was employed with the Born approximation, and the scattering of particles by vibrational and rotational states was investigated within the framework of the Bohr–Mottelson model. (KSW)

16221 (JINR–D–6465, pp 449–466) MULTI-STEP EFFECTS IN TRANSFER REACTIONS. Luk'yanov, V. K. (Joint Inst. for Nuclear Research, Dubna, USSR). 1972. (In Russian).

The stripping reaction A(d,p)B illustrates the process of neutron transfer, and one-step and two-step processes are discussed for this reaction type. Multi-step stripping in the theory of disturbances, two-step stripping of spherical nuclei, and channel coupling with deformed nuclei are additional facets of the discussion. Specific (d,p) reactions are examined for the nuclei ^{52}Cr, ^{44}Ca, ^{24}Mg, ^{238}U, and ^{176}Yb. (KSW)

16222 (JINR–D–6465, pp 467–490) DEFORMATION ENERGIES AND NUCLEAR FISSION. Strutinskii, V. M. (Inst. of Nuclear Research, Kiev). 1972. (In Russian).

Shell structure and equilibrium forms of a nucleus are discussed in their relation to energy levels in a single-particle spherical potential well. The energy surface for large deformations are examined in terms of fissile nuclei and (d,pf) reactions. Intermediate states in fission, threshold and asymmetry, and times of spontaneous fission are explored in this context. (KSW)

16223 (JINR–D–6465, pp 491–525) DEVELOPMENT OF MICROSCOPIC THEORY OF COLLECTIVE EXCITATIONS. Belyaev, S. T. (Inst. of Nuclear Physics, Novosibirsk, USSR). 1972. (In Russian).

The microscopic model, as an aggregate of nucleons (quasiparticles), is assumed to move in a self-consistent potential well and associated with interacting forces. Other attributes of the model are discussed: the pairing of forces, a "realistic" nucleon–nucleon interaction, and new types of "spin-orbital" oscillations. A comparative analysis is made of approximation methods: Hartree–Fock, chaotic phase, and a "diagonal approximation." Density matrices in expanded space and collective space are described as methods for microscopic description. (KSW)

16224 (JINR–D1–6349) PROCEEDINGS OF THE IVth INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS AND NUCLEAR STRUCTURE, DUBNA, USSR, SEPTEMBER 7–11, 1971. Dzhelepov, V. P. (ed.). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 670p. (In Russian and English). (CONF-710911).

Separate abstracts were prepared for 34 of the papers presented in this volume. The remaining two, on pion and kaon absorption by nuclei and the status of the Clinton P. Anderson Meson Physics Facility, have already appeared in NSA as abstracts 26: 14204 and 25: 53421. (RWR)

For abstracts of individual papers see: 14852, 15352, 15465, 15466, 15756, 15757, 15805, 15808, 15820–15823, 15865, 15869, 15903–15906, 16045–16047, 16065, 16094, 16154, 16168, and 16225–16233.

16225 (JINR–D1–6349, pp 77–90) SOME INFORMATION ON THE PROGRESS IN HYPERNUCLEAR PHYSICS. Pniewski, J. (Univ., Warsaw).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Recent results obtained in hypernuclear physics and some of the conclusions that can be deduced from these results are discussed. The promising perspectives for the future work are shown. The main problem presented is the study of excited states of hypernuclei. (LBS)

16226 (JINR–D1–6349, pp 93–116) DIRECT REACTIONS IN MEDIUM ENERGY NUCLEON INTERACTIONS WITH NUCLEI. Komarov, V. I. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Direct nuclear reactions which occur in light nuclei under the action of medium-energy nucleons (~0.1 to 1.0 GeV) were examined with a view toward obtaining data on the cluster structure of nuclei and short-range correlations between nuclear nucleons. Specific reactions discussed are (p,2p), (p,Nd), (p,πd), (p,π^3H), and (p,π^3He). Elastic nucleon–nucleus scattering with large momentum transfer to the light nucleus was studied for information on inner cluster structure in quasi-elastic knock-on reactions. (5 figures) (KSW)

16227 (JINR–D1–6349, pp 117–39) MECHANISMS OF PION NUCLEAR REACTIONS AT HIGH ENERGIES. Leksin, G. A. (Inst. of Theoretical and Experimental Physics, Moscow). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Reactions of the type p + A → product were investigated, where the product might be represented by p + p + B, d + π^+ + B, or d + B, and the energies involved were of the order of 80 MeV. Reaction mechanisms are discussed in terms of Feynman diagrams. (11 figures) (KSW)

16228 (JINR–D1–6349, pp 167–84) HIGHLY EXCITED STATES OF NUCLEI. Balashov, V. V. (Moscow State Univ.). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

Partial transitions during the inelastic scattering of hadrons by nuclei are illustrated by examples taken from the literature. The problem of the giant resonance in excited nuclei is discussed: the resonance mechanism of μ capture is shown to be similar to that of the radiative capture of π^- mesons. The structure of the spectrum of nuclear excitation above the giant resonance is examined. Experimental data on (γ,γ') reactions point to the existence of a special range of giant resonance states in nuclei. Calculations were carried out for the ^{12}C nucleus in the Born approximation for the electron. For comparatively small transferred momenta collective 1^- and 2^+ states are easily visible in the continuous spectrum, manifest in the form of resonances in the spectrum of the scattered electrons. (7 figures, 1 table) (KSW)

16229 (JINR–D1–6349, pp 185–97) STUDY OF NUCLEON ASSOCIATION IN HIGH-ENERGY REACTIONS. Neudachin, V. G. (Moscow State Univ.). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

A special function $\tilde{\phi}_0$ (R) was calculated for the relative motion of the α–d association in the ^{6}Li nucleus. A phase-shift analysis of α–α scattering is given from 0 to 125 MeV. Form factors are plotted as functions of the center-of-mass momentum for α–d and ^{3}He–t cases. (KSW) (4 figures)

16230 (JINR–D1–6349, pp 241–50) SEVERAL PROBLEMS IN THE THEORY OF NONRADIATIVE PION CAPTURE BY NUCLEI. Kopaleishvili, T. I. (Tbilisi State Univ., USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The study of nonradiative pion capture, represented by $\pi^\pm$ + A → B* + NN, often furnished new information on the structure and properties of the nucleus. The two-particle mechanism of absorption for this reaction, the occurrence of a wave function of the final state of the system, and the absence of a pion absorption process with a separate nucleon in the free state are discussed. Feynman diagrams were constructed for the reaction pp → dπ^+. (KSW)

16231 (JINR–D1–6349, pp 251–64) CHARGE EXCHANGE REACTIONS OF PI MESONS ON NUCLEI. Becker, F. (Lab. of Theoretical Physics, Strasbourg).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The properties of single and double charge-exchange reactions of π mesons on nuclei are briefly reviewed, and a discussion is given of how these reactions could be used to probe neutron and proton densities. (LBS)

16232 (JINR-D1-6349, pp 393-410) INFLUENCE OF THE MOLECULAR STRUCTURE OF MATERIALS ON NUCLEAR PION CAPTURE PROCESSES. Ponomarev, L. I. (Joint Inst. for Nuclear Research, Dubna, USSR). (In Russian).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

A discussion of the Z-law (Fermi and Teller, 1947) involves deceleration and capture of mesons, the transition from continuous spectrum to highly excited meso-atomic levels, nuclear capture, and de-excitation processes. The probability of capture by a given nucleus is related to the deceleration of μ^-, π^-, and K^--mesons in chemical compounds. Capture of μ^--mesons should be principally by nuclei with a large charge. (KSW)

16233 (JINR-D1-6349, pp 543-64) ELECTROMAGNETIC INTERACTIONS WITH NUCLEI. Walecka, J. D. (Stanford Univ., CA).

From 4th international conference on high energy physics and nuclear structure; Dubna, USSR (7 Sep 1971). See CONF-710911.

The electromagnetic interaction is ideal for studying nuclear structure. An electromagnetic probe sees the local current density in the target; the interaction is known, and the target structure can be directly examined. In addition, the interaction is weak; hence, the probe does not alter the structure of the target. If the target is unpolarized and unobserved, then to lowest order the electromagnetic response can be summarized in two tensors whose coefficients, $W_{1,2}$, are functions of the Lorentz scalars q_λ^2 and $q \cdot p$. These surfaces $W_{1,2}$ contain all the information on the strong-interaction structure that can be obtained by means of an electromagnetic probe. Experimental work on inelastic scattering to discrete levels is examined. The particle–hole model is discussed, with emphasis on the giant resonances and other negative-parity oscillations of closed-shell nuclei. The following conclusions were drawn: the particle–hole structure in the region 10 to 30 MeV seems to become clearer at large q, where well-defined groupings of states show up strongly—in particular, high-spin states can dominate the spectrum at large q; the q^2 dependence of the peaks serves as a valuable tool in identifying the levels, and some of the complexes still show diffraction minima; the particle-hole model is extremely successful in predicting the location of the states, generally to better than 1 MeV, and in predicting the inelastic form factors out to $q \cong 700$ MeV/c—however, the amplitudes may be too large by factors of the order of $\sqrt{2}$; the effects of the spin-flip 1^- and 2^- states, which are believed to play a dominant role in μ capture, are clearly seen in inelastic electron scattering. The quasielastic peak, electron excitation of the nucleon itself, and the total photoabsorption cross section for a nuclear target at high energy are also discussed. (23 figures) (RWR)

16234 (JINR-P2-6683) BARYON POLARIZATION AT SMALL ANGLE SCATTERING BY NUCLEI. Lapidus, L. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 24p. (In Russian). Dep. NTIS (U. S. Sales Only).

The magnetic moment effect in polarization in small-angle baryon–nucleus scattering is considered. For S-wave neutron-nucleus scattering, new experiments on Wolfenstein's parameter A measurement with polarized neutron beams become very interesting at small angles. The measurement of the A parameter in the conditions of Kuchnir's et al. experiment gives a possibility of direct reconstruction of the real part of the scattering amplitude (not only the model). For neutron energy below about 0.5 MeV, the atomic screening becomes important. At high energies where hadronic amplitudes are essentially imaginary the polarization P_0 becomes close to 100% at small t_M. The value and the sign of polarization at small t are connected with the value and the sign of the baryon magnetic moment. This makes possible the determination of hyperon and anti-neutron magnetic moments. For polarization effects in small angle charged baryon-nucleons scattering the net polarization effect is strongly reduced in value when comparing with neutral baryon scattering due to the effect of non-spin flip singular charge–charge interaction. At high energy there is a small angle interval where polarization effects due to magnetic moment interaction are not small. The difference in the electromagnetic interaction of neutrons and protons, e.g., gives rise to the non-small violation of isospin prediction for polarization effects at small t even when baryons are scattered by nucleons with zero isospin. The analogous statement is valid for the polarizations of nucleons and hyperons in the frame of SU_3 symmetry. (auth)

16235 (JINR-P4-6782) ON THE ANALOG OF THE BOHR HAMILTONIAN FOR PAIR VIBRATIONS. Dzholos, R. V.; Kartavenko, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 12p. (In Russian). Dep. NTIS (U. S. Sales Only).

The properties of the Hamiltonian, constructed for description of collective pair excitations, are studied. The case of strong pair correlations is analyzed. All the parameters of the Hamiltonian are calculated. (auth)

16236 (JINR-P7-6741) FISSION AND DECAY OF EXCITED NUCLEI. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Reactions). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The statistical theory of the decay of excited nuclei is considered including the competition between particle emission and fission. Fission barriers are given by a phenomenological formula which is an analog of the known Cameron formula and approximates well experimental data on nuclei up to transuranic elements. The contribution of shell corrections and odd-even effects is discussed. The calculated ratios of evaporation and fission widths Γ_n/Γ_f agree with experiment even in the region of nuclei with $Z > 90$. The Γ_n/Γ_f values depend weakly on excitation energy for nuclei with $Z \cong 90$, while in other regions this dependence proves rather strong. The last conclusion does not contradict known experimental data since in experiment one usually measures some effective value $\langle\Gamma_n/\Gamma_f\rangle$, which is only indirectly related to the real Γ_n/Γ_f values. It is shown that the calculated values of $\langle\Gamma_n/\Gamma_f\rangle$ do not practically depend on excitation energy too. The effects of angular momentum and uncertainty in the choice of level density parameter are discussed. (auth)

16237 (JINR-P7-6798) STATISTICAL THEORY OF DECAY OF FISSIONING COMPOUND NUCLEI IN HEAVY ION REACTIONS. Barashenkov, V. S.; Zheregi, F. G.; Il'inov, A. S.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 16p. (In Russian). Dep. NTIS (U. S. Sales Only).

Fission-evaporation competition of deexcitation of the compound nuclei produced in heavy ion reactions is considered on the basis of statistical approach. Calculations are carried out by the Monte Carlo method. Excitation functions $^{A_1}Y(^{A_2}X,xn)^{A_1+A_2-X}Z$ and an energy dependence of fission cross section $\delta_f(T)$ are analyzed. Relative (not normalized to the cross sections) rather than absolute results agree with experiment in a better way. In every case a good agreement between theoretical and experimental data can be achieved by special fitting of parameters, however, it is hardly ever possible to catch any qualitative objective low in a variation of these parameters when passing from one case to another. One can state that the agreement becomes better, as a rule, if the ratio of level density parameters for fissioning and evaporating nuclei $\alpha_f/\alpha_n > 1$, moreover this ratio is apparently closer to unity for heavier nuclei. Calculation results are quite sensitive to the value α_f/α_n. It is very hard to get a satisfactory agreement between theory and experiment in the range of high energies for incident ions $T \simeq 10$ MeV/nucleon, that shows the necessity to take into account some direct processes and a non-equilibrium decay of excited nuclei. (auth)

16238 (RT/FI-(72)37) EFFECT OF REDUCED WIDTH AMPLITUDE SIGNS IN THE MULTILEVEL CALCULATION OF NEUTRON CROSS SECTIONS. Motta, M. (Comitato Nazionale Per L'Energia Nucleare, Rome (Italy)). Sep 1972. 27p. Dep. NTIS (U.S. Sales Only).

The effect of the uncertainties in the attribution of signs of the reduced width amplitudes is numerically examined in the case of a multilevel and two-channel calculation of neutron cross sections. Two examples are given together with a short description of the FORTRAN code used in the calculations. (4 figures, 3 tables) (auth)

16239 (TID-26243) SHELL STRUCTURE FOR DEFORMED NUCLEAR SHAPES. Sheline, R. K.; Ragnarsson, Ingemar; Nilsson, S. G. (Lund Inst. of Tech. (Sweden)). 1972. 22p. Dep. NTIS.

Eigenvalues for the harmonic oscillator without $\underline{l} \cdot \underline{s}$ or $\underline{l}^2$ terms suggest a deformed shell structure for nuclei with axes ratios 2:1 and deformation $\epsilon = 0.6$ with corresponding nucleon "magic numbers" 2, 4, 10, 16, 28, 40, 60, 80, 110, 140, subject to small modifications due to spin–orbit and other correction terms. Experimental evidence of reasonably stable highly deformed structures corresponding to nucleon numbers 16, 20, 28, 40, and 60 (64) is presented. Attempts to calculate the cor-

responding potential energy surfaces by using the Strutinsky shell-correction method are described. (auth)

16240 MULTIPLE SCATTERING AND NUCLEAR INFORMATION. Kujawski, E. (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., C; 7: No. 1, 18-29(Jan 1973).

One-dimensional scattering from two mobile rectangular potential wells in a bound state is studied in order to investigate the contributions from the overlapping-potential region. The above model is used to compare the exact solution in the "fixed-scatterer" approximation with the corresponding ones obtained by assuming nonoverlapping potentials and additivity of phase shifts. The kinematics of the "fixed-scatterer" and "impulse" approximations are also examined, and the differences are found to be still significant at intermediate energies. For nonoverlapping potentials the composite scattering is completely determined in terms of the individual scattering coefficients or on-shell information, and the solution is given by a linear system of coupled algebraic equations. Unfortunately, as far as scattering information is concerned, the overlapping-potential region is the interesting one, since it offers the possibility of discriminating among phase-shift-equivalent potentials and of determining the short-range behavior of the wave function. The results suggest that the predictions provided by the nonoverlapping potentials or additivity of phase-shifts assumptions deviate sufficiently from the exact result to render ambiguous the extraction of the distribution function or two-body interaction from elastic intermediate-energy scattering in terms of either of these two models. (auth)

16241 OBTAINABILITY OF TWO-BODY OFF-SHELL INFORMATION FROM ELASTIC NUCLEON–NUCLEUS SCATTERING AT INTERMEDIATE ENERGY. Adelberg, M. L.; Saperstein, A. M. (Wayne State Univ., Detroit). Phys. Rev., C; 7: No. 1, 63-74(Jan 1973).

Off-shell two-body T matrices are included in both the unary and binary terms of the optical potential derived from Watson's multiple-scattering theory. A wholly momentum-space-oriented approach is taken: all calculations are performed in terms of momentum variables, and spatial coordinates do not appear. It is concluded that it is not possible at present to obtain definitive information on the off-shell nucleon–nucleon T matrix from intermediate-energy elastic nucleon–nucleus scattering. On the other hand, the size of the off-shell effect is sufficiently large that it is not possible unambiguously to select a model for the pair-correlation function without a definite model for the off-shell nucleon–nucleon scattering amplitude. (6 figures) (auth)

16242 NUCLEONIC ENERGY IN NUCLEAR MATTER AND IN REAL NUCLEI. Dutta, A. K. Phys. Rev., C; 7: No. 1, 103-106(Jan 1973).

A critical consideration of the Bethe–Weizsaecker relation shows that the surface tension term in it is not appropriate for determining the decrease in nuclear binding energy due to surface effects. The unsuitability of this term makes reconsideration of the expression for energy dependence on nuclear forces imperative, and suggests a different approach for the purpose. The energy per nucleon in nuclear matter of different nuclei with an equal number of protons and neutrons and unaffected by Coulomb and asymmetry effects has been found to increase logarithmically with nucleon numbers. It is considered that the increase in energy per nucleon with increasing nucleon number in such ideal nuclei is caused by increasing superposition effects of internucleonic forces and is determinable on statistical considerations. The energy in nuclear matter of different nuclei thus obtained actually measures the energy caused by nucleonic forces in the Bethe–Weizsaecker relation, dependent on nucleon numbers only. The expression for ideal energy of nuclei, reduced by suitable expressions for the decrease in energy because of the different conditions of actual nuclei, determines the corresponding expected values. These different amounts of reduction in energy are controlled by the internucleonic forces in ideal conditions and hence by the energy per nucleon in nuclear matter. The complete expression for the expected nucleonic energy for optimum condition, isobaric nuclei, and different excited states in real nuclei is given. The experimental energy per nucleon in strongly bound nuclei of different nucleon number finds good agreement with only the first repulsive term in this expression. (1 figure) (auth)

16243 NEW INTEGRODIFFERENTIAL EQUATION AND INTEGRAL CONSTRAINT FOR THE CORRELATION FUNCTION BETWEEN TWO NUCLEONS IN NUCLEAR MATTER. Grypeos, M. E. (Univ. of Thessaloniki, Greece). Phys. Rev., C; 7: No. 1, 95-102(Jan 1973).

A nonlinear integrodifferential equation for the correlation function between two nucleons in nuclear matter is obtained. This equation results from writing the (trial) expression of the energy per particle in nuclear matter in a suitable form and subsequently applying the variational principle. The investigation of the behavior of the equation for large internucleon distances leads to a new integral constraint on the correlation function. (1 table) (auth)

16244 DISTORTED-WAVE THEORY OF MULTISTEP PROCESSES. Robson, D. (Princeton Univ., NJ). Phys. Rev., C; 7: No. 1, 1-9(Jan 1973).

The theory of multistep processes based upon the distorted-wave Born approximation as a leading term is investigated. Iterative procedures in which the many-body Green's operator for the complete system is replaced by a non-Hermitian or optical Green's operator are shown to have some unappealing features. Alternative procedures using a nonlinear form of the distorted transition matrix equation, corresponding to a dispersion-theory approach, are discussed and appear to provide a more consistent iterative procedure. A generalized optical theorem is derived and used to sum the multistep amplitudes which conserve energy. The summed result shows that the normal distorted-wave matrix element should be replaced by a modified leading term unless the absorption in initial and final states is weak. Difficulties with the theory involving multistep amplitudes off the energy shell and a new calculable form for two-step processes are suggested. (auth)

16245 ATOMIC COULOMB EXCITATION BY HEAVY CHARGED PARTICLES. Hansteen, J. M.; Mosebekk, O. P. (Univ. of Bergen, Norway). Nucl. Phys.; A201: No. 3, 541-560(1973).

Recent experimental results have necessitated further studies of atomic Coulomb excitation induced by heavy charged projectiles such as protons, deuterons, α-particles, etc. The earlier semi-classical model (the SCA model) has been applied in the adiabatic as well as the non-adiabatic projectile energy region. Impact parameter dependences and total cross sections are evaluated and discussed for various electron shells. Further experiments are suggested to test the validity of the SCA model. (auth)

16246 ISOVECTOR CURRENT–CURRENT PROCESSES IN NUCLEAR PHYSICS. Christillin, Paolo (Univ., Pisa, Italy); Rosa-Clot, M. Phys. Rev., C; 7: No. 1, 44-50(Jan 1973).

Processes involving two vertices are analyzed in nuclear physics. By means of an appropriate isospin analysis, corrections to the usual single-particle Hamiltonian arising from nuclear correlations are explicitly given for Compton scattering and muon and pion radiative capture. In particular the $\Delta T = 2$ channel is seen to play a fundamental role in radiative muon capture for medium and heavy nuclei, where its contribution to the rate amounts to $\sim 10\%$ for ^{40}Ca and affects sensitively the estimates of g_p. (auth)

16247 ELASTIC MAGNETIC ELECTRON SCATTERING AND NUCLEAR MOMENTS. Donnelly, T. W.; Walecka, J. D. (Stanford Univ., CA). Nucl. Phys.; A201: No. 1, 81-106(1973).

Just as elastic Coulomb scattering provides the best picture of the nuclear charge distribution, elastic magnetic electron scattering out to high momentum transfer brings out fine details of the nuclear ground-state current and magnetization distributions. A series of theoretical observations on the multipoles contributing to elastic magnetic scattering is presented including a detailed analysis of the forms of the multipole operators and single-particle current densities, and a pictorial representation of these quantities is given. Then a general theoretical analysis of the nuclear matrix elements of the multipole operators is presented. A unified analysis of this process throughout the periodic table from A = 3 to 209 is presented using single-particle wave functions (both harmonic oscillator and Woods–Saxon) with parameters determined entirely from elastic charge scattering. This analysis is compared with the rather limited existing data. Finally, the relation to isoelastic semi-leptonic weak processes is discussed, and it is shown that electron scattering provides an essentially model-independent basis for the analysis of these processes. (auth)

16248 SPIN-FLIP SCATTERING OF PIONS BY NUCLEI. Futami, Y. (Tokyo Univ.); Kohmura, T. Progr. Theor. Phys. (Kyoto); 48: No. 5, 1563-1568(Nov 1972).

Inelastic scattering of pions from nuclei is discussed to give information on nuclear structure. The differential cross section at small angles is related to the beta and gamma transitions. Discussion is simplified for the spin-flip scattering. (auth)

16249 T NONCONSERVATION IN NUCLEAR MUON CAPTURE. Oziewicz, Z. (Univ., Wroclaw). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 91-100(1968).

The correlations nonconserving T-parity in radiative muon

capture in allowed and first forbidden transitions are calculated. The imaginary part of Gamov–Teller interaction is introduced. The results are compared with the nuclear β-decay. (auth)

16250 WEAK INTERACTIONS OF NUCLEONS IN THE NUCLEUS. Szymanski, Z. (Univ., Warsaw). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 130-137(1968).

A review is given of weak interactions between nucleons in the nucleus. The effects of these interactions on various nuclear properties are discussed. Parity and time reversal invariance violations are considered. (JFP)

16251 QUASI-SPIN METHOD IN NUCLEAR SPECTROSCOPY. Szpikowski, S. (M. C. Sklodowska Univ., Lublin, Poland). Zesz. Nauk. Uniw. Jagiellon., No. 177, Pr. Fiz.; No. 6, 139-145(1968).

The aim of the lecture is to represent some applications of the quasi-spin method to nuclear spectroscopy. The first remark about the quasi-spin method was made in 1958 by Anderson, and Wada et al. in connection with the superconductivity. Then, Kerman and independently Helmers applied it to nuclear spectroscopy. Lipkin, who worked also in this domain, discusses this method. More widely the method was exploited in 1964 to 65. The lecture consists of three parts: introduction to the method; application to exact solution of the pairing Hamiltonian; application to the improvement of the classification of nuclear states. This last application was widely discussed elsewhere, and only a short remark about it is made. (auth)

16252 OFF-THE-ENERGY-SHELL T MATRIX. I. SINGLET STATE. Takemiya, T. (Kumamoto Univ., Japan). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1547-1562(Nov 1972).

A simple method is presented to obtain the two-body off-energy-shell T matrix at a positive energy. As an example of a realistic potential, the Hamada–Johnston potential in the singlet state is assumed. In the present method, the off-shell Lippman–Schwinger equation is solved under suitable boundary conditions. From its solution, an expression for the off-shell element of T matrix is derived. The off-shell behavior of reduced T matrix is investigated on the angular-momentum states J = 0 and J = 1 at energy parameter 75 MeV. (auth)

16253 ELASTIC AND INELASTIC SCATTERINGS OF HEAVY IONS. Matsuzaki, H. (Tohoku Univ., Sendai). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1534-1546(Nov 1972).

The angular distributions of the elastic and inelastic scatterings of heavy ions from nuclei are analyzed. The strong absorption model is employed to the elastic scattering and the inelastic scattering exciting the target and/or projectile. The inelastic scattering amplitudes are evaluated by making use of the derivative relation of Austern and Blair. A good agreement with the experimental data is obtained. The deformation lengths $\beta_l R$ are determined from the inelastic scattering data, which are found to be consistent with previous analyses. (auth)

16254 ^{9}Be AS A THREE BODY PROBLEM WITH SEPARABLE INTERACTIONS. Chand, T. Columbia, S. C.; Univ. of South Carolina (1972). 259p. University Microfilms Order No. 72-25,906.

Thesis.

The structure of the ^{9}Be nucleus was investigated as composed of two alpha particles and a neutron. For the nuclear interactions between these particles, a separable S wave alpha–alpha interaction and separable $S_{½}$, $P_{½}$, and $P_{⅝}$ alpha-neutron interactions were used. These interactions reproduce low energy scattering data. Some of the essential features, properties and varieties of widely used separable potentials are discussed in detail. After reviewing the past work done on ^{3}H, ^{3}He, ^{6}Li, ^{6}He, and ^{12}C and describing the difficulties associated with the three body problem, the Faddeev equations are derived. For each value of the total angular momentum and parity of the system, the Faddeev equations are reduced to a set of coupled one-dimensional integral equations. This reduction requires some angular integrations, the procedure for which is outlined. The one-dimensional integral equations are solved numerically to find the bound states in three channels, $J^P = ½^-$, $½^-$, and $½^+$. Each of these channels has a single bound state. The binding energy for these states is compared with the experimental values and possible sources of error given. Some components are then given concerning the numerical procedure followed and possible uncertainties involved in the final result due to numerical errors. Having obtained the binding energy for each channel, its wave function is obtained. The wave function consists of two parts; one is explicitly known and the other is obtained numerically. These wave functions are then normalized. The previously neglected Coulomb interaction is taken into account to obtain corrections to the energy levels by a perturbation method. Only the first order term is considered. The results of the Coulomb calculations are discussed in terms of the wave function for each channel. At the end, the scope of the future work is outlined. The formalism for the form factors, quadrupole moment and the root mean square radius is given. The work shows that ^{9}Be can be considered as composed of two alpha particles and a neutron. (Diss. Abstr. Int., B)

16255 NUMBER-CONSERVING SETS. Ellis, P. J.; Jackson, A. D.; Osnes, E. (Univ. of Oslo). Nucl. Phys.; A196: No. 1, 161-77(1972).

Various calculations were made of two number-conserving sets of diagrams which contribute to the effective interaction in third order using a variety of forces. While there is in general a cancellation between the individual diagrams in these two sets, the degree of cancellation is not sufficiently high that the contribution to the effective interaction of third-order number-conserving sets may be neglected as small in comparison with most other third-order diagrams. (auth)

16256 REVIEW OF INTERMEDIATE ENERGY PHOTOFISSION. Forkman, B.; Schroeder, B. (Tekniska Hoegskolan, Lund, Sweden). Phys. Scr.; 5: No. 3, 105-15(1972).

The photofission process at intermediate energies is reviewed and comparison is made with fission processes induced by pions, nucleons and heavy ions. The photofission cross section in medium-heavy and heavy elements is discussed at photon energies both below and above the photomeson threshold. Single fragment kinetic energy spectra, fragment mass distributions and the angular distribution of fission fragments are treated and discussed from simple interaction models. (auth) (Sweden)

16257 TEST OF THE POLE APPROXIMATION FOR $(\alpha,2\alpha)$ REACTIONS AT MODERATE ENERGIES. Avakov, G. V.; Dolinskii, E. I.; Turovtsev, V. V. (Inst. of Nuclear Physics, Moscow). Nucl. Phys.; A196: No. 3, 529-46(1972).

The quasi-elastic knock-out mechanism of the $(\alpha,2\alpha)$ reaction is studied in the pole approximation. In this approximation the reaction amplitude contains only the on-mass-shell amplitudes describing the virtual emission of the α-cluster by a target nucleus and the $\alpha-\alpha$ elastic scattering. The calculated angular correlation functions and energy spectra are compared with the experimental ores for the $(\alpha,2\alpha)$ reactions on 1p shell nuclei at different incident energies. The main attention is focussed on the problem of choosing the relative energy, E_c, of two colliding α-particles in the $\alpha-\alpha$ scattering cross section. It follows from the calculations that the pole-model fits the data only qualitatively and that there is no single universal E_c prescription suited for all bombarding energies and for all targets. (auth)

16258 ANALYSIS OF ELASTIC ELECTRON SCATTERING ON LIGHT NUCLEI ON THE BASIS OF SYMMETRIZED FERMI-DENSITY DISTRIBUTION. Eldyshev, Yu. N.; Luk'yanov, V. N.; Pol, Yu. S. (Joint Inst. for Nuclear Research, Dubna, USSR). Yadern. Fiz.; 16: No. 3, 506-14(Sep 1972). (In Russian).

With the help of analytic expressions for charge form factors, obtained for symmetrized Fermi-density distribution, data on elastic electron scattering on ^{4}He, ^{6}Li, ^{12}C and ^{16}O have been analyzed. For all the nuclei (including the known data on middle nuclei) it is possible to reach agreement with the experiment up to some bound value q_0, which is determined for each nucleus by its mean-square radius and is connected with atomic number in accordance with the empirical relation $q_0 \approx 7.7\ A^{-⅓}$. Here in the domain $q < q_0$ it was the density structure on the nuclei boundary ($r \approx R$) that manifests itself most effectively, vice versa in the $q > q_0$ domain these are the structure details of intranuclear density behavior. It is shown that the Born approximation is qualitatively valid for the domain $q \lesssim q_0$ and nuclei with $Z < 8$. (auth)

16259 TWO-PARTICLE ELECTRODISINTEGRATION OF ^{3}He. Kozlovskii, I. V.; Tartakovskii, V. K.; Fursa, A. D. (Inst. of Theoretical Physics, Kiev). Yadern. Fiz.; 16: No. 3, 497-505(Sep 1972). (In Russian).

The process of electrodisintegration of ^{3}He(e,e'p)d is considered including the pd interaction. The Gaussian wave function is used for the ground state of ^{3}He, and the final state wave function takes into account the interaction between resulting proton and deuteron in the S-state only. It is shown that in many cases the ^{3}He electrodisintegration cross section depends essentially on the final-state interaction. (auth)

16260 ISOBARIC CONFIGURATION 0^+-STATES, PROTON–NEUTRON HOLE IN A SPHERICAL NUCLEUS. Gaponov, Yu. V.; Lyutostanskii, Yu. S. (Inst. of Atomic Energy, Moscow). Yadern. Fiz.; 16: No. 3, 484-96(Sep 1972). (In Russian).

The spectrum of analog and isobaric configuration 0^+-states

of spherical nuclei from As to La has been studied in the framework of finite Fermi-systems. These excitations of even–even core are of proton–neutron hole type and manifest themselves as levels of 0^+ characteristics in adjacent odd–odd nucleus. The mean difference between proton–neutron single particle potentials has been clarified. A general expression for the energy of configuration 0^+-states has been obtained in quasiclassical approximation. Numerical calculations of their positions have been performed. (auth)

16261 SOME PROPERTIES OF THE TWO-BODY EFFECTIVE INTERACTION AS DETERMINED FROM NUCLEAR SPECTRA AND NUCLEAR REACTION. Lanford, William Armistead. Rochester, N. Y.; Univ. of Rochester (1972). 134p. University Microfilms Order No. 72-18,817.

Thesis.

The $^{209}Bi(^4He,t)^{210}Po$ and $^{209}Bi(^3He,d)^{210}Po$ reactions have been studied, and the members of the multiplets corresponding to two protons in the $h_{9/2} \times h_{9/2}$, $h_{9/2} \times 2f_{7/2}$, and $h_{9/2} \times i_{13/2}$ shell model configurations have been identified. The goodness of the seniority quantum number for identical nucleons in $j = 9/2$ orbits has been studied by investigating the mixing of the $|(9/2)^3\ J = 9/2\ v = 1\rangle$ and $|(9/2)^3\ J = 9/2\ v = 3\rangle$ states. This admixing has been calculated using the fractional parentage expansion to be less than $1/10$ of one percent for the $g_{9/2}$, $h_{9/2}$, and $2g_{9/2}$ orbits. The $^{92}Mo(^4He,t)^{93}Tc$ and $^{92}Mo(^3He,d)^{93}Tc$ experiments were performed to check this calculation for the $g_{9/2}$ orbit. The result of these reactions put an upper limit of 3% on the admixing, in agreement with the calculated result. In addition, it has been shown that the most general interaction which exactly preserves seniority gives an r.m.s. deviation from the observed $(9/2)^2$ spectra of less than 16 keV for the present cases. The proton–neutron effective interaction has been studied by examining matrix elements extracted from proton–neutron weak-coupling nuclear spectra. A multipole analysis shows that these matrix elements are consistent with an interaction of the form $V_{12}^{p-n} = V_0(1 + \alpha\,\sigma_1 \cdot \sigma_2)e^{-(r/r_0)^2}$ with $\alpha \sim 1/10$ and $r_0 = 0.8 \pm 0.8$ f. Finally, the general two-body effective interaction has been studied by examining complete sets (both T = 0 and T = 1) of matrix elements extracted from two-nucleon weak coupling spectra. A multipole analysis of this rather limited set of matrix elements indicated that the effective interaction must have a multipole decomposition similar to that of an interaction of the form $V_{12} = V_0(1 + 1/10\,\sigma_1 \cdot \sigma_2)e^{-(r/r_0)^2} - V_0^\tau\,1/2(1 + \tau_1 \cdot \tau_2)$ with $r_0 \sim 0.8$ f. (Diss. Abstr. Int., B)

16262 DETERMINATION OF OFF-SHELL t-MATRIX FROM pp BREMSSTRAHLUNG DATA AT 42 MeV. Celenza, L. S.; Gibson, B. F.; Liou, M. K.; Sobel, M. I. (Brooklyn Coll.). Phys. Lett.; 42B: No. 3, 331-4(11 Dec 1972).

We search for the best fit to pp bremsstrahlung data at 42 MeV, varying parameters describing the off-shell t-matrix and the internal term. We obtain a χ^2 minimum with internal term small, and t-matrices differing moderately from Hamada–Johnston values. (auth)

16263 SOLAR NEUTRINOS AND A PROPOSED LEVEL IN ^6Be. Barker, F. C. (Australian National Univ., Canberra). Phys. Lett.; 42B: No. 3, 313-14(11 Dec 1972).

Arguments are given against the existence of a narrow 0^+ level in ^6Be just above the $^3He + {}^3He$ threshold, which has been postulated recently in order to explain the low observed flux of solar neutrinos. (auth)

16264 PHASE TRANSITION IN NUCLEAR MATTER AND NONPAIR NUCLEAR FORCES. Migdal, A. B. (Inst. of Theoretical Physics, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 6, 1993-9(Dec 1972). (In Russian).

The π meson spectrum in nuclear matter is found by taking into account nucleon correlations. It is shown that two branches exist in the meson spectrum. When the density is less than that of the nucleus an instability of the meson field arises, and this leads to a phase transition which changes the ground state energy of the nuclei and should result in additional meson scattering by nuclei. Distortion of the meson Green function in nuclear matter significantly affects the internucleon forces. These changes are lost in the usual approach based on the assumption of pair interaction. (auth)

16265 STRUCTURE OF RESIDUAL INTERACTION IN SPHERICAL NUCLEI. Kamchatnov, A. M.; Nosov, V. G. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 6, 1961-77(Dec 1972). (In Russian).

The effect of residual interaction between nucleons (quasiparticles) on shell oscillations of spherical nuclear masses is considered. The singularity of the ground state energy of the system in the vicinity of nucleon magic numbers is analyzed for various types of dependence of residual interaction on orbital momentum of the quasiparticle. It is shown that only the perturbation band width of the Fermi distribution due to residual interaction which is proportional to the square of the angular momentum vector, is consistent with the character of the magic cusps. The coupling constants between the quasiparticles are determined on basis of available data. The constant rapidly decreases with increase of nuclear radius. Possible consequences pertaining to the energy spectrum of infinite nuclear matter are discussed. (auth)

16266 CALCULATION OF INTERNAL CONVERSION COEFFICIENTS FOR ALL ATOMIC SHELLS. Alder, K.; Raff, U.; Baur, G. (Univ., Basel). Helv. Phys. Acta; 45: No. 5, 771-7(1972).

Today extensive calculations of internal conversion coefficients (ICC), including screening and finite nuclear size effects, are available for the K, L, M and N_1 through N_5 atomic shells. In the present paper conversion coefficients for all atomic shells and various nuclear charge numbers, Z, are calculated with Hartree–Fock–Slater bound state wave functions and compared to approximate calculations and to experimental results. The knowledge of theoretical outer shell conversion coefficients offers the possibility of evaluating the change in total electron density $\Delta|\psi(0)|^2$ at the nucleus for isotopes decaying in two different chemical compounds. (auth)

16267 LOW-LYING STRUCTURE AND INELASTIC SCATTERING OF Cu ISOTOPES IN A UNIFIED MODEL. Castel, B.; Johnstone, I. P.; Singh, B. P.; Stewart, K. W. C. (Queen's Univ., Kingston, Ont.). Can. J. Phys.; 50: No. 14, 1630-43(15 Jul 1972).

The odd-Cu isotopes are examined in a model which couples quasi-particle states to anharmonic vibrations of neighboring Ni cores. The $f_{5/2}$, $f_{7/2}$, $p_{3/2}$, and $p_{1/2}$ orbitals are available and the core properties are taken directly from the experimental spectrum of the Ni isotopes. The results are compared with experimental estimates as well as with a recent shell model calculation. The inelastic scattering cross sections for protons on ^{65}Cu are also discussed within the framework of this model. (auth)

16268 ALPHA-DECAY HALF-LIVES OF HEAVY AND SUPERHEAVY ELEMENTS. High, M. D. (Univ. of Indiana, Bloomington); Malmien, R.; Malik, F. B. Helv. Phys. Acta; 45: No. 5, 738-45(1972).

The known alpha-decay half-lives of transuranium elements can be reproduced using an interaction potential having a repulsive core. Results are insensitive to the magnitude of the core height but the derived nuclear half-density radius = $1.1\ A^{1/3}$ F. is consistent with those obtained from the analysis of mu-mesic and electron scattering experiments. Using this model and theoretical Q-values from Green's mass formula, the upper limits of alpha-decay half-lives of $(112)^{292,294,298,296,300}$, $(114)^{294,296,298,300,302}$, and $(126)^{310,312,314,316,318}$ are computed. For isotopes of elements 112, our calculations barely overlap with those of Nilsson et al. For isotopes of element 114, our estimated half-lives are considerably shorter than those of Nilsson et al. but agree with those of Grumann et al. For isotopes of 126, our calculated half-lives are longer than those estimated by Muzychka. (auth)

16269 PARTICLE-NUCLEUS SCATTERING AT INTERMEDIATE ENERGIES. Best, M. E. (McGill Univ., Montreal). Can. J. Phys.; 50: No. 14, 1609-13(15 Jul 1972).

For incident neutron energies between 20 MeV and 10 GeV the total neutron–nucleus ($A \geq 12$) cross sections were calculated using Glauber theory. Remarkably good agreement between experiment and theory was found at energies above 250 MeV. Using the same formalism with identical nuclear parameters, the π^-–C cross sections were calculated for incident pion energies near the (3,3) resonance. In this case, however, good agreement between theory and experiment was found for pion energies above 150 MeV. (auth)

16270 COULOMB EXCITATION EFFECTS IN NEUTRON-TRANSFER REACTIONS. Morf, R. H.; Alder, K. (Univ., Basel). Helv. Phys. Acta; 45: 1094-1116(1972).

A time-dependent semiclassical picture is used to describe the virtual Coulomb excitation occurring in subcoulomb neutron transfer reactions. This leads to coupled differential equations for the amplitudes of the nuclear states involved. Numerical results of the virtual electric quadrupole excitation effects are given for typical neutron transfer reactions. (auth)

16271 DYNAMIC DEFORMATION EFFECTS IN THE COMPOUND NUCLEUS REACTIONS. Kalinkin, B. N.; Permyakov, V. P.; Shilov, V. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Acta Phys. Pol.; B3: No. 4, 475-84(1972). (In Russian).

The effective radius value for strong interaction of two nuclei,

which is obtained in analyzing the differential cross section of elastic scattering, is discussed. (auth)

16272 QUARTET STATES IN THE sd AND fp SHELLS. Jaffrin, A. (CEN de Saclay, Gif-sur-Yvette, France). Nucl. Phys.; A196: No. 3, 577-92(1972).

Two-proton–two-neutron correlations are studied in psd and fp shell nuclei in the frame of the aligned scheme approximation. Four-particle rotational states are obtained in terms of linear combinations of projected aligned Slater determinants and the resulting excitation energies and wave functions are compared with those of elaborate shell-model calculations. The close agreement obtained both for single j-shell and complete shell configuration spaces shows that rotational or quasi-rotational states are almost entirely generated by aligned configurations. The lowest four-particle states obtained in one j-shell can be explained as the rotational spectrum of an oblate intrinsic state. The lowest four-particle states of ^{16}O, ^{20}Ne, ^{44}Ti and ^{60}Zn, calculated in a major shell, correspond to the rotational spectrum of a prolate intrinsic state and fit the existing data. Higher states are the result of a mixed deformation. (auth)

16273 ZERO ORBITAL ANGULAR MOMENTUM TRANSFER REACTIONS INDUCED BY ^{6}Li IONS. Clement, C. F. (United Kingdom Atomic Energy Research Establishment, Harwell, Eng.); Perez, S. M. Nucl. Phys.; A196: No. 3, 561-76(1972).

An example of a zero orbital angular momentum transfer reaction is the mutual excitation of ^{6}Li ions to their T = 1, 0^+ states at 3.56 MeV. An experimental angular distribution for this reaction is fitted using a distorted-wave theory and also an extension of the adiabatic theory of Austern and Blair. Reasonable fits are obtained in terms of one parameter, the strength of the spin-flip, isospin-flip component of the effective nucleon–nucleon force. Applications of the theory to similar reactions and the inclusion of exchange terms in the amplitude are considered. (auth)

16274 NUCLIDIC MASS RELATIONSHIPS. Jaenecke, J. (Max-Planck-Institut fuer Kernphysik, Heidelberg); Behrens, H. Z. Phys.; 256: No. 3, 236-42(1972).

Arguments are presented which show that the transverse and longitudinal nuclidic mass relationships of Garvey and Kelson (GK-T and GK-L) contain small but systematic errors. If masses far off the line of β-stability are calculated, these errors accumulate in the repeated application of the relationships, and the diverging predictions from GK-T and GK-L seem to represent estimates of upper and lower limits only. A new generalized nuclidic mass relationship is introduced. (auth)

16275 BOUNDARY CONDITION MODEL FOR DIFFRACTIVE ELASTIC SCATTERING. Strobel, G. L. (Kernforschungsanlage, Juelich, Ger.). Z. Phys.; 256: No. 3, 210-25(1972).

Diffractive elastic scattering is studied by a boundary condition model that does not utilize a potential model. S-matrix elements are calculated and compared to those found from an optical potential model calculation. The unitarity of the model is related to the boundary condition imposed. A radially ingoing boundary condition is imposed on the wave function at one angle only, at a scattering angle of 180°. This condition is required to hold in the vicinity of the nuclear radius, but not for all radii. Elastic scattering peaks at forward and backward angles are reproduced and discussed. The model is applied to composite particle scattering above the Coulomb barrier. (auth)

16276 RPA CALCULATION OF THE EFFECTIVE CHARGE IN A HARTREE–FOCK BASIS. Ellis, P. J. (Univ. of Oslo); Osnes, E. Contract AT(11-1)-3001. Phys. Lett.; 42B: No. 3, 335-40(11 Dec 1972).

Using a Hartree–Fock basis the diagrams of the Tamm–Dancoff and random-phase approximations have been summed to calculate the effective charge in the (1s0d) shell. The enhancement of the effective charge found by this summation is much less than in an oscillator basis, in fact in most cases the HF RPA result is smaller than the value obtained from the lowest order core polarization diagram in an oscillator basis. The HF neutron effective charges are thus too small. For protons the enhancement of the bare effective charge in a HF basis must also be taken into account, but for cases involving the $0d_{\frac{5}{2}}$ orbital the final result appears rather small. (auth)

16277 TWO-STEP PROCESS IN THE $^{210}Pb(p,d)^{209}Pb$ REACTION. Igarashi, M. (Tokyo Medical Coll.); Kawai, M.; Yazaki, K. Phys. Lett.; 42B: No. 3, 323-7(11 Dec 1972).

The $^{210}Pb(p,d)^{209}Pb$ reaction leading to the single particle states ^{209}Pb has been analyzed. In the weak transitions to the $1i_{\frac{13}{2}}$, $3d_{\frac{5}{2}}$, $4s_{\frac{1}{2}}$, $2g_{\frac{9}{2}}$, and $3d_{\frac{3}{2}}$ single particle states the contribution of the two-step process $p \rightarrow t \rightarrow d$ was found to be of the same order of magnitude as the direct pick-up process. The calculated cross sections taking both the direct pick-up and the two-step processes into account agree well with the experimental ones. Two step processes via inelastic scattering were found to be small. (auth)

16278 EXACTLY SOLUBLE SHELL MODEL WITH R(5) SYMMETRY EXHIBITING TWO-DIMENSIONAL VIBRATIONS AND ROTATIONS. Chattopadhyay, P. K.; Krejs, F.; Klein, A. (Univ. of Pennsylvania, Philadelphia). Phys. Lett.; 42B: No. 3, 315-18(11 Dec 1972).

It is shown that a representation of the algebra R(5), previously utilized to construct an exactly soluble shell model with pairing and monopole interactions, can be reinterpreted so as to yield (with a different Hamiltonian!) a model exhibiting the spectrum of a two-dimensional rotator-vibrator as well as a Coriolis antipairing transition at high angular momentum. (auth)

16279 SOME REMARKS ON MAGNETIC DIPOLE MOMENTS IN LIGHT NUCLEI. Van Hienen, J. F. A.; Glaudemans, P. W. M. (Rijksuniversiteit, Utrecht). Phys. Lett.; 42B: No. 3, 301-3 (11 Dec 1972).

Multi-shell mixed-configuration calculations employing various effective interactions show that for low-lying states the g-factor in $T_z = 0$ nuclei as well as the average of g-factors of corresponding states in mirror nuclei varies between +0.4 and +0.9 n.m. in rather good agreement with a pure j^n description; for excited states in even-even $T_z = 0$ nuclei one finds $g \approx +0.50$ n.m. The results agree well with present experimental data on magnetic dipole moments of ground states and excited states. (auth)

16280 VERY NEUTRON RICH LIGHT NUCLEI. Garvey, G. T. (Princeton Univ., NJ). Comments Nucl. Particle Phys.; 5: No. 3, 85-8(May 1972).

The question as to how many neutrons a specified number of protons can bind is discussed. This is proving difficult to answer experimentally for any but the lightest nuclei ($Z \leq 5$). The basic reason for the difficulty is that the answer to the question lies far from the valley of β stability and leads to a study of nuclear matter with larger N/Z ratios (~2.5 to 3) than are customarily studied. An attempt is made to ascertain if nuclear models, such as the shell model, applied in the valley of stability, yield comparably good results for these more exotic species. It is particularly important to find whether the nuclear density alters; if the density decreases for large values of N/Z there would be a dramatic change in the total binding energy of the nucleus. Liquid drop theories of the nucleus are inappropriate for light nuclei and are extremely unreliable away from β stable nuclei, and some other kind of theory is necessary to give guidance as to what masses should be expected for these neutron rich nuclei. The most useful strategy at present available employs equations relating mass differences, allowing the use of existing data to predict masses of yet unobserved nuclei. In some special cases, however, more conventional and better understood theories, based on the nuclear shell model, may be employed. In addition to the basic interest these nuclei hold for nuclear physicists information regarding their neutron binding energies is of great importance to astrophysicists investigating the "r" process of nuclear synthesis. The present experimental states of these problems is summarized, and directions for further studies are indicated. Work is described on ^{10}He, ^{11}Li, ^{12}Be, ^{14}B, and ^{15}B. In some of this work it was interesting to find a nucleus far off the stability line more stable than predicted by current reasonable theories. The recent real progress in the subject of neutron rich light nuclei lies with the heavy ion program at the Russian Dubna cyclotron. Seventeen new isotopes have been reported from the bombardment of ^{232}Th with 290 MeV ^{40}Ar, including ^{21}N, ^{34}O, and ^{25}F. 16 references. (UK)

16281 MATRIX ELEMENTS FOR SPIN CURRENT TRANSITIONS IN THE INELASTIC ELECTRO-EXCITATIONS OF NUCLEI BY USING DIFFERENT VECTOR POTENTIAL DECOMPOSITIONS. Joenperae, Ilmari (Univ. of Helsinki). Ann. Acad. Sci. Fenn., Ser. A VI; No. 397, 5-34(1972).

The transverse part of the four-potential created by the current of the plane wave electron can be decomposed into two parts, one of which is a gradient of a scalar. Through the use of the continuity equation and integrating by parts it is shown that the interaction independent (charge density) parts of the decompositions above are different. Only in the long-wavelength limit ($kR \ll 1$), where R is the range of the N–N-interaction, the charge density parts of the decompositions treated are identical. In order to examine the interaction dependent (current density) parts of the three decompositions the spin current is included. Explicit values of the matrix elements have been calculated for different decompositions using spherical harmonic oscillator wave functions. The calculations show the validity of Siegert's theorem up to the mo-

mentum transfer k = 0.5 fm^{-1}, but only if one compares two terms in the current density matrix elements. Serious errors may arise if one compare one term of order $(kr)^2$ in the interaction dependent part with the other in the charge density part of the matrix elements, and neglect the current density term. (auth)

16282 EXPLICIT EXPRESSIONS OF THE ONE-PARTICLE SU_3-INVARIANT DENSITY MATRIX FOR GROUND SU_3 CONFIGURATIONS OF NUCLEI. Vanagas, V. V. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 1, 89-94(1972). (In Russian).

The complete set of relations for determining the one-particle SU_3-invariant density matrix in explicit form is presented in the case of ground SU_3 configurations of nuclei. (auth)

16283 ACCURACY ESTIMATION OF THE APPROXIMATE EXPRESSION FOR BARTLETT AND HEIZENBERG POTENTIAL ENERGY. Vanagas, V. V.; Gorskite, Ya. Ch. (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 1, 95-104(1972). (In Russian).

Two universal relations between matrix elements of the density matrix used for calculation of Bartlett and Heisenberg potential energy of nuclei are given. Some illustrative examples for the accuracy estimation of the approximate expressions of Bartlett and Heisenberg potential energy of nuclei are discussed. (auth)

16284 SUPERHEAVY ELEMENTS AND NONLINEAR ELECTRODYNAMICS. Rafelski, J. (Univ., Frankfurt am Main); Greiner, W.; Fulcher, L. P. Nuovo Cim.; 13B: No. 1, 135-160 (11 Jan 1973).

Maxwell's equations, which underlie electrodynamics, are linear equations. Nonlinear effects, such as photon–photon scattering, are known to arise in quantum electrodynamics, and one might expect them to become important in the case of strong external fields. The consequences of a class of nonlinear Lagrangians, which includes that of Born and Infeld and whose common property is that they lead to upper limits for the electric-field strength (somewhat analogous to the upper limit for the velocity of a particle in special relativity), are investigated. These nonlinear Lagrangians also lead to a finite electromagnetic self-energy for the electron, unlike the case of Maxwellian electrodynamics. The importance of nonlinear effects of course depends upon the size of the upper limit to the electric-field strength. If this upper limit is determined by requiring that the mass of the electron is of an entirely electromagnetic origin, nonlinear effects become very important in determining the eigenvalues of electrons bound to superheavy nuclei. For example, the 1s energy eigenvalue is raised by 270 keV for Z = 164. The Lagrangians considered do not lead to an absolute gap between bound states and the states of the lower continuum; the 1s energy eigenvalue becomes equal to −0.511 MeV, where the lower continuum begins, for Z = 215. An analogy between nonlinear electrodynamics and higher-order vacuum polarization corrections is studied. (auth)

16285 NOTE ON THE l-DEPENDENCE OF THE $\alpha-\alpha$ INTERACTION. Rahman, M.; Ali, S.; Afzal, S. A. (Atomic Energy Centre, Dacca, Pakistan). Lett. Nuovo Cim; 6: No. 3, 107-110 (20 Jan 1973).

It is pointed out that there are phenomenological indications that a purely attractive l-independent $\alpha-\alpha$ potential can reproduce the scattering phase shifts quite satisfactorily. It is emphasized that phenomenologically l-dependence of the $\alpha-\alpha$ interaction is not essential and that the existence of a repulsive part in the two-body $\alpha-\alpha$ interaction over and above the actual Coulomb potential is not indispensible. (JFP)

16286 ONE-PARTICLE ASPECTS OF THE FISSION PROCESS. Szymanski, Z.; Wycech, S. (Inst. for Nuclear Research, Warsaw). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 149(1969).

The knowledge of nuclear energy dependence on deformation is required in order to understand the occurrence and magnitude of fission barriers. The properties of nuclear spontaneous fission are determined essentially by the magnitude of the nuclear effective inertial parameter B. Preliminary calculations of this parameter are performed in the adiabatic approximation. The estimates of B seem to indicate that the saddle-point position occurs at deformation of the order of $\epsilon \cong 0.5$ to 0.7. (JFP)

16287 RESIDUAL INTERACTION IN NUCLEI. Bochnacki, Z. (Inst. of Nuclear Physics, Krakow). Zest. Nauk. Uniw. Jagiellon., No. 202, Pr. Fiz.; No. 7, 151-155(1969).

The discussion of residual interactions in nuclei covers the reaction matrix as the residual interaction operator and effective force for diagonalization within one shell and the field-producing part of the effective interaction. (JFP)

16288 FROM SOFT TO REAL PIONS IN NUCLEAR PHYSICS. Ericson, M. (CERN, Geneva); Rho, M. Phys. Rev.; 5C: No. 2, 57-124(1972).

This review treats the applications of soft-pion theorems to nuclei. After a general introduction to the soft-pion techniques, the partially conserved axial vector current hypothesis is discussed and its particular nature in the nuclear case is emphasized. The mass extrapolation problem is treated. The relation between the physical and the soft-pion amplitude is derived for several processes, and its physical interpretation is discussed. (auth)

16289 SHELL MODEL THEORY OF ELASTIC SCATTERING OF NUCLEONS BY DEFORMED NUCLEI. Domcke, W.; Froebrich, P. (Technische Univ., Munich). Z. Phys.; 258: No. 1, 1-11(1973).

The escape width originating from a collective rotational state as a doorway state is calculated in the framework of the shell model theory of nuclear reactions. The rotational states are constructed by Yoccoz–Peierls angular momentum projection from deformed intrinsic states which are described by BCS wave functions. For some rare earth nuclei it is shown that there result escape widths of the order of magnitude of 20 to 100 keV. (auth)

16290 UNIFIED MODEL DESCRIPTION OF SOME NUCLEI IN THE N = 49 region. Kitching, J. E. (McGill Univ., Montreal). Z. Phys.; 258: No. 1, 22-37(1973).

The unified model has been applied in a description of the structures of ^{91}Mo, ^{89}Zr, and ^{87}Sr as well as to the lighter strontium nuclei ^{85}Sr and ^{83}Sr. The quasiparticles $1g_{9/2}$, $2p_{1/2}$, $2p_{3/2}$, $1f_{5/2}$, $2d_{5/2}$, $3s_{1/2}$, and $2d_{3/2}$ have been coupled to the vibrations of the cores. An improvement over the earlier shell model calculations is obtained for the strontium nuclei while for N = 49 nuclei the prediction of anomalous states populated in some direct reaction studies is achieved. (auth)

16291 SCHROEDINGER EQUATION FOR COLLECTIVE MOTION FROM THE GENERATOR COORDINATE METHOD. Banerjee, B. (Technische Univ., Munich); Brink, D. M. Z. Phys.; 258: No. 1, 46-55(1973).

It is shown that if the collective wave function occurring in the Griffin–Hill–Wheeler integral equation is slowly varying, the equation can be transformed into a Schroedinger equation. The conditions under which this can be done are studied in detail. (auth)

16292 MODEL CALCULATION IN A NEW APPROACH TO THE THREE-BODY PROBLEM. Gloeckle, W.; Ueta, K. (Univ., Heidelberg). Z. Phys.; 258: No. 1, 64-80(1973).

A method to calculate the binding energy of a system of three identical particles is proposed. The kernel of a previously derived integral equation in two variables is replaced by an approximation of finite rank. It turns out that a one term approximation is already sufficient to determine the binding energy very well. (auth)

16293 INFLUENCE OF NON-CENTRAL INTERACTIONS ON LOW LYING STATES OF ^{24}Mg. Feldmeier, H.; Manakos, P.; Wolff, T. (Technische Hochschule, Darmstadt, Ger.). Z. Phys.; 258: No. 1, 81-98(1973).

Shell model calculations of low-lying positive parity states of ^{24}Mg have been performed in an SU(3) truncated space. In contrast to previous SU(3) model calculations the experimental spectrum can be reproduced well. This is attained by variation of a certain noncentral component of the residual interaction. (auth)

16294 RECENT DEVELOPMENTS IN RANDOM-MATRIX THEORY. Brody, T. A.; Flores, J.; Mello, P. A. (Univ. Nacional de Mexico, Mexico City). Rev. Mex. Fis.; 21: No. 2, 141-166 (1972).

The aim of random-matrix theory is to provide a coherent account of the statistical properties of complex quantum systems; its most important applications have been to nuclear physics. The work that has been carried out in recent years in this field is reviewed, after providing a brief description of the basic ideas derived from earlier work. Attention is paid to the comparison with experimental data. (10 figures, 1 table) (auth)

16295 BOUND PION ABSORPTION BY NUCLEI AND NUCLEAR SHORT-RANGE CORRELATIONS. Morris, J. W. Jr. Charlottesville, VA; Univ. of Virginia (1972). 132p. University Microfilms Order No. 72-23,436.

Thesis.

The absorption of negative pions by nuclei is used as a means to study nuclear short-range correlations. By kinematics, predominantly two nucleons are singled out by the absorption and subsequently emitted in opposite directions with equal energy. Since

the relative momentum of the pair is usually 50 to 100 MeV/c more than typical nuclear wells can furnish, the (π^-,NN) reaction should give direct access to ground state short-range correlations. However, sensitivity to these bound state correlative effects may be lost due to the complex final-state interaction of the emitted nucleon pair in the continuum of the residual nucleus. In an attempt to treat the final-state realistically, both the optical potential of the residual nucleus and the nucleon–nucleon interaction have been included in a three-body partial wave analysis. In numerical applications to the reaction $^{12}C(\pi^-,NN)$, the effects of the residual nuclear well were found to be appreciable as well as those of a nucleon–nucleon Reid soft-core type interaction between the emerging nucleons. The main conclusion is that a reasonable agreement with experiment cannot be obtained for this model without including in the bound state short-range correlations having dominant momentum components of ~300 MeV/c, which are parameterized in terms of Jastrow-type correlation functions. (Diss. Abstr. Int., B)

PHYSICS (PLASMA AND THERMONUCLEAR)

Confinement and Heating

16296 (TRITA-EPP-72-26) ON THE SCALING LAWS OF PERMEABLE AND IMPERMEABLE TOKAMAK PLASMAS. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 19 Nov 1972. 38p. Dep. NTIS (U. S. Sales Only).

The effects of plasma–neutral gas interaction on the equilibrium and stability of Tokamak plasmas are considered: (i) There exists a critical ion density limit n_c dividing laboratory plasmas into a permeable and an impermeable class, having different equilibrium and stability properties as well as different scaling conditions and ranges of possible operation. (ii) Tokamak experiments have so far been performed in the permeable range, and the obtained results cannot necessarily be extrapolated to full-scale fusion reactors which are likely to operate in the impermeable range. (iii) The stability and plasma density limits obtained from the present theory are consistent with the experiments, also in the case of recently performed adiabatic toroidal compression studies. Consequently, the latter do not prove that the density limit has been surpassed. (iv) Provided that stability can be secured in the boundary layer of permeable plasmas, there should exist a possible region of operation of Tokamak reactors in the range above n_c. In such a system the plasma pressure cannot be balanced by the pressure of a surrounding neutral gas blanket. (auth)

16297 (TRITA-EPP-72-29) SHOCK HEATING OF PLASMA BY MEANS OF SUPERPOSED FIELDS AND MAGNETIC ENERGY STORAGE. SOME NEW IDEAS. Halmoey, E. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Dec 1972. 28p. Dep. NTIS (U. S. Sales Only).

The advantages of magnetic vs. electrostatic energy storage for pulsed plasma applications are evaluated. The method of superposition of magnetic fields to generate both acceleration and an equilibrium force of long duration is discussed. A new scheme, superposing two superconducting circuits with constant initial currents, is suggested. Solutions are found for the currents as the inner conductor is deformed in one dimension. The current solutions are combined with the momentum equation of the snowplow model to give the speed of a plasma current sheet as a function of position. The decay of a plasma current at rest and its effect on the equilibrium force are considered briefly. The feeding and switching of the high currents in the superconductors are discussed and approaches to these problems are suggested. It is demonstrated how this method of field superposition can be modified to produce colliding shocks in a coaxial geometry or a toroidal theta pinch. (auth)

16298 (UCB-34-P-128-21) FIRST SEMIANNUAL PROGRESS REPORT OF 1972 ON PLASMA RESEARCH, 1 JANUARY–30 JUNE 1972. (California Univ., Berkeley. Electronics Research Lab.). 1972. Contract AT(04-3)-34. 122p. Dep. NTIS.

Experimental and theoretical research is described for the following areas: (1) multiple mirrors, (2) electron cyclotron heating, (3) effects of electron temperature on cavity perturbation measurements, (4) intense electron beam experiment, (5) impurity mixing instability, (6) suppression of grid effects in simulation plasmas, (7) heating of magnetized plasmas by a large-amplitude lf electric field, and (8) plasma diffusion across a magnetic field in three dimensions. (MOW)

16299 (UCB-34-P-128-X-3) HEATING OF MAGNETIZED PLASMAS BY A LARGE-AMPLITUDE LOW-FREQUENCY ELECTRIC FIELD. Chen, Liu; Birdsall, C. K. (California Univ., Berkeley. Coll. of Engineering). Jun 1972. 63p. (ERL-352). Dep. NTIS.

Plasma electron and ion heating due to a large-amplitude oscillating electric field E_0 applied normal to a steady magnetic field B_0 was followed in detail by one-dimensional computer simulations. The large oscillating drift velocity ($E_0/B_0 > v_e$) at low frequency ($\omega_{ci} \ll \omega_0 \simeq \omega_{pi} \ll \omega_{ce}$) sets up instabilities due to the periodic electron E/B drift through the ions, which then cause rapid heatings. For waves propagating across B_0 ($\vec{k} \cdot \vec{B}_0 = k_{||} = 0$), the instability is a Buneman-type upper-hybrid two-stream instability. Electron perpendicular thermal velocity is increased to $\sim E_0/B_0$ with little ion heating. For obliquely propagating waves ($k_{||} \neq 0$), there is an additional instability, the modified two-stream instability. For small $k_{||}$ (roughly, $k_{||}/k \lesssim \sqrt{m_e/m_i}$), the upper-hybrid instability dominates and the heating is similar to the $k_{||} = 0$ case but with a small amount of electron parallel heating. As $k_{||}$ increases, however, the modified two-stream instability becomes dominant. Electron parallel thermal velocity is increased to $\simeq (E_0/B_0)(k/k_{||})$. Strong ion (perpendicular) heating also occurs with the ion thermal velocity at wave saturation near $(E_0/B_0)(m_e/m_i)^{1/4}(k/k_{||})^{1/4}$. Comparison with similar work with $B_0 = 0$ shows that addition of B_0 is best for ion heating, improving KT_i by $(m_i/m_e)^{1/4}$. Possible applications of these results to laboratory experiments are also discussed. (auth)

16300 PLASMA DIFFUSION IN THE PRESENCE OF WAVES. Gratzl, H. (Kernforschungsanlage, Juelich, Ger.). Nucl. Fusion; 12: No. 6, 683-688(Dec 1972).

Diffusion in plasma is considered with the help of the moment equations. If low-frequency waves are present that move the ions, diffusion can arise due to nonlinearly saturated waves which cause an energy transfer from electrons to ions, or also due to growing waves. Already in weak turbulence the order may exceed the classical diffusion, e.g., for resistive drift waves. In slab geometry the diffusion (or the anomalous resistance) depends in the case of electrostatic waves on the Coulomb force $n_i E_\perp$, n_i being the ion perturbation and $E_\perp$ the electric field of the waves perpendicular to the density gradient and to the magnetic field. In an axisymmetric torus the diffusion is changed essentially by a factor $(1 + \vec{E} \cdot \vec{B}/\vec{E} \cdot \vec{B})$, since electric fields parallel to the magnetic field contribute. (auth)

16301 MEASUREMENT OF THE ENERGY LIFETIME OF THE IONS IN THE TO-1 TOKAMAK. Ivanov, N. V.; Kovan, I. A. JETP Lett. (USSR) (Engl. Transl.) 16: No. 7, 300-1 (5 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 7, 423-5(5 Oct 1972).

An important characteristic of thermal insulation of a plasma in a closed magnetic trap of the tokamak type is the time of conservation of the thermal energy in the ionic component of the plasma. Until recently, this quantity was usually determined from the energy-balance equation, based on the assumption that the energy is transferred from the electrons by the Coulomb mechanism in Joule heating of the plasma. Experiments with the TO-1 setup yielded the dependence of the energy content of the plasma on time in the case of magnetosonic heating of the ions, which permitted a second independent estimate of τ_{Ei}. It is of interest to compare the ion energy lifetime determined from this dependence with the value calculated from the energy-balance equation. (auth)

16302 GAS-DYNAMIC DESCRIPTION OF A PLASMA IN A CORRUGATED MAGNETIC FIELD. Mirnov, V. V.; Ryutov, D. D. (Inst. for Nuclear Physics, Novosibirsk, USSR). Nucl. Fusion 12: No. 6, 627-636(Dec 1972).

The movement of plasma along a corrugated magnetic field with corrugation scale l smaller than the charged-particle free-path length λ is considered. It is shown that when the scale of longitudinal inhomogeneity of the plasma L is large compared with λ, the movement of the plasma can be described macroscopically. A closed system of macroscopic equations is obtained for the case of a strongly corrugated field ($H_{max}/H_{min} \gg 1$) and several solutions are found for this system. It is shown that corrugation considerably slows down the longitudinal expansion of the plasma compared with a smooth field and also suppresses the longitudinal thermal conductivity to a marked degree. The results obtained are of interest for controlled nuclear fusion research. (auth)

16303 DEMONSTRATION OF HIGH-FREQUENCY INDUCTION HEATING OF PLASMA LOCATED IN A CLOSED NULL-FIELD LINE. Kawahata, K.; Matsuura, K.; Kuroda, T.; (and others) (Nagoya Univ., Japan). Nucl. Fusion; 12: No. 6, 727-728(Dec 1972).

It is demonstrated that a radiofrequency (rf) oscillating electric power is fed, to a remarkable extent — of about one half of the output power of the oscillator — into the plasma trapped in a closed line of a null field. This experiment was originally planned for the investigation of further heating of a plasma stably confined in the toroidal theta-pinch machine named Caulked-Cusp Torus. The C.C.T. configuration is formed by periodically arranging many caulked-cusp fields along the minor axis. Then, a closed line of the null field exists beneath each ring, and the confined plasma particles are able to gather there. (auth)

16304 EFFECT OF THE MAGNETIC FIELD RIPPLE ON DIFFUSION IN TOKAMAKS. Stringer, T. E. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Nucl. Fusion; 12: No. 6, 689-694(Dec 1972).

The magnetic field modulation due to the discrete nature of the field coils in a Tokamak leads to additional particle trapping. The

resulting diffusion is evaluated and compared with the neoclassical diffusion. The two diffusion rates are found to be comparable in existing Tokamaks. The limit on the field ripple below which ripple diffusion should be negligible in the next generation of machines is evaluated. (auth)

16305 ANOMALOUS DIFFUSION OF AXISYMMETRIC TOROIDAL PLASMAS. Dobrowolny, M. (European Space Research Inst., Frascati, Italy); Nocentini, A. Lett. Nuovo Cim.; 6: No. 3, 94-98(20 Jan 1973).

A consistent theory is presented, based on the solution of the Vlasov equation, for anomalous diffusion due to low-frequency electrostatic instabilities in an axisymmetric toroidal plasma. The results of the theory are then discussed in relation to typical Tokamak plasmas. (MOW)

16306 TRANSVERSE INJECTION OF PLASMA INTO A LINEAR, STELLARATOR-LIKE MAGNETIC FIELD. Chambers, R. G. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). Plasma Phys.; 14: No. 11, 1017-1034(Nov 1972).

A plasma injector capable of injecting $\sim 8 \times 10^{16}$ ion–electron pairs into the separatrix of a linear, stellarator-like magnetic field is described. A further $\sim 4 \times 10^{17}$ ion–electron pairs go to the vacuum walls and are lost, during the injection. The total energy of the injected plasma trapped in the separatrix is ~5 J, and the transverse ion temperature is in the range 100 to 300 eV. A theory is described which attempts to explain some of the plasma loss taking place during the injection. Results of other plasma flow and plasma energy measurements are presented. A double-Langmuir-probe study of the injected plasma shows that the electron temperature has an upper limit of about 20 eV. Measurements with an ion energy analyzer show that the ions are moving with mean energy ~50 eV along the magnetic field. A prediction is made of the suitability of this sort of injector for filling a large toroidal stellarator. (auth)

16307 ENERGY-LOSS EFFECTS ON TURBULENT HEATING. Gerber, K. A.; Goldenbaum, G. C. (Naval Research Lab., Washington, DC). Phys. Lett., A; 42A: No. 5, 339-340(1 Jan 1973).

Experimental evidence is presented for the effect of electron energy loss on determining the type of cross-field electron streaming instability that develops in low-density, high-temperature plasmas. (auth)

16308 HIGH-INTENSITY CO_2 LASER–PLASMA INTERACTION. Burnett, N. H.; Kerr, R. D.; Offenberger, A. A. (Univ. of Alberta, Edmonton). Opt. Commun.; 6: No. 4, 372-376(Dec 1972).

High power CO_2 laser radiation was used to break down low pressure hydrogen gas inside the optical cavity. Preliminary results of a search for the stimulated Compton effect resulting from the laser–plasma interaction are reported. The magnitude of the observed red shift in the transmitted laser radiation indicates that inverse bremsstrahlung dominates the plasma heating for the prevailing experimental conditions. (auth)

Diagnostics

16309 (BMBW-FBK-72-22) SPECTROSCOPIC METHODS FOR MEASURING THE TEMPERATURE IN PLASMA COLUMNS WITH SELF-ABSORPTION. Meiners, D. (Technische Universitaet, Hanover (West Germany). Institut Fuer Plasmaphysik). Nov 1972. 89p. (In German). Dep. NTIS (U.S. Sales Only).

Spectroscopic methods are surveyed for measuring the temperature in plasmas with self-absorption. Special attention is given to those methods that allow the determination of the complete radial temperature distribution in inhomogeneous plasma columns. Techniques for measuring the optical thickness and for solving the integral equation for the local emission coefficient are discussed, and an ALGOL program for calculating T(r) is presented. For Bartels' method easily usable formulas are given, including induced emission and iterative improvement of the radial temperature distribution. (auth)

16310 (FRNC—TH-226) STUDY OF THE SEED ELECTRONS PRODUCED BY A LASER BEAM IN A GAS WITH A PROPORTIONAL GAS COUNTER. Louis-Jacquet, M. (Paris Univ., Orsay (France)). 1970. 122p. (In French). NTIS (U. S. Sales Only).

Thesis.

A proportional counter and the associated electronics were developed in view of studying the electrons and ions produced by a laser beam in a gas. The instrumentation developed enabled work to be carried out at pressures ranging from 10 to 760 torr and quantities of electrons and ions ranging between 10 and 5×10^6 to be collected. The instrumentation also enabled the exact origin of the charges collected to be determined. The curves representing the number of electrons collected in the gas as a function of the laser intensity having crossed the counter are presented. It is shown that the initial creation of the electrons is due to the multiphoton ionization of the gas atoms. The evolution of the cascade was then studied. (France)

16311 (ORNL—4834) HEAVY-ION BEAM DESIGN CALCULATIONS FOR THE ORMAK AND ELMO BUMPY TORUS DEVICES. McNeilly, G. S. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 25p. Dep. NTIS.

Beam probes are a promising plasma diagnostic tool, since the heavy-ion beam is capable of sampling the plasma locally, thus allowing measurements of fine spatial resolution. It is desirable that the locus of points of second ionization of the beam—the detector line—be as nearly straight as possible and pass through the center of the plasma. This allows a more convenient unfolding of the experimental results. In addition, for ORMAK, intervening coils must be avoided as much as possible. These constraints, as well as the probe's physical limitations, determine the limits of the calculations described. (auth)

16312 NEUTRAL-POTASSIUM-BEAM MEASUREMENT OF PLASMA DENSITY. Finlayson, V. A.; Coensgen, F. H.; Nexsen, W. E. Jr. (Univ. of California, Livermore). Nucl. Fusion; 12: No. 6, 659-662(Dec 1972).

A 6-keV beam of potassium atoms was used to measure the integrated line density of a deuterium plasma in which the electron temperature was in the range of a few hundred eV, and the mean ion energy was in the range of 5 to 10 keV. Line densities from 5×10^{11} to 10^{14} particles per cm^2 can be effectively measured. The various contributions to the attenuation of the neutral beam were examined in sufficient detail to permit an evaluation of this measurement to a wide range of plasma conditions. (auth)

16313 SPECTROGRAPHIC PLASMA TEMPERATURE MEASUREMENTS ANALYZED BY STATISTICAL METHODS. Murino, P. (Univ., Naples). Aerotec.-Missili Spazio; 50: 352-359(Dec 1971). (In Italian).

A description is given of a method of solving the Abel integral equation in spectroscopic determinations of plasma temperatures. A numerical solution of the Abel equation is obtained by a method based on the approximation of the lateral intensity of the emitted radiation by a sum of polynomials which are orthogonal with respect to a suitable weight function. The polynomials which have been taken into account were those whose coefficients, evaluated by the linear regression technique, could be regarded as nonzero at a certain confidence level. This method is regarded as interesting, since it shows little sensitivity to random measurement errors but is nevertheless sufficiently accurate numerically. (IAA)

16314 COMPUTER OPTIMIZATION OF THE THREE COIL MAGNETIC PROBE. Pachner, J. Jr. (Univ. of British Columbia, Vancouver). Can. J. Phys.; 50: No. 21, 2726-2734(1 Nov 1972).

Results of the computer investigation of the performance of the three coil magnetic probe, described in an earlier paper by Curzon et al., are presented. (auth)

16315 REPELLING ANALYZERS FOR THE INVESTIGATION OF RAREFILED LOW-ENERGY PLASMA. Pervushin, I. I.; Shyutte, N. M. (Radio-Engineering Inst., Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 3, 742-744(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 3, 112-114(1972).

Repelling analyzers (or focusing traps) constitute a new type of instrument for recording streams of charged particles and analyzing them with respect to energy and arrival angle. These instruments differ from well-known traps and analyzers in a new recording method: the particles are repelled by means of an electrostatic field and focused onto a collector. The calculations allow the optimal parameters of the instrument to be determined. (auth)

Kinetics (General)

Refer also to abstract 15705.

16316 (AD-746068) NONEQUILIBRIUM PHENOMENA IN FLOWING PLASMAS FOR MHD POWER GENERATION AND PROPULSION SYSTEMS. Progress Report, February 15, 1971–February 14, 1972. Eustis, R. H.; Kruger, C. H.; Mitchner, M. (Stanford Univ., Calif. Dept. of Mechanical Engineering). May 1972. Contract F44620-68-C-0051. 7p. (AFOSR-TR-72-1295). NTIS.

The report discusses progress on work pertaining to non-

equilibrium phenomena in flowing plasmas. Measurements of vibration-translation and vibration-vibration relaxation rates in rapid expansions of mixtures of N_2 and CO_2 in argon were made. The results generally exceed those measured in shock-heating and laser-fluorescence experiments, and indicate a deficiency in available theory. Experiments were conducted to investigate the influence of channel size on the ionization instability, in order to provide a means of extending information on small scale devices to predictions for full sized power generators. It was found, for example, that the effective Hall parameter decreased with increasing channel size. A mathematical model was formulated to predict the effect of N_2 addition on the nonequilibrium properties of argon and alkali-metal-seed plasmas. Agreement between calculated and experimental values of electrical conductivity was quite satisfactory. (auth)

16317 (CEA-CONF-2102) INFLUENCE OF ATOM–ATOM COLLISIONS ON ELECTRON DENSITY DECAY IN LASER-PRODUCED HELIUM PLASMAS. Drawin, H. W. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 96p. (CONF-720729-1). Dep. NTIS (U. S. Sales Only).

From 6th Yugoslav Symposium and Summer School on the physics of ionized gases; Split, Yugoslavia (16 Jul 1972).

Theoretical and experimental work on recombination coefficients is described. A non-LTE model was used to calculate the collisional–radiative volume recombination and ionization coefficients for helium plasmas. The experimental part consisted of determining the volume decay coefficient for laser-produced helium plasmas. (MOW)

16318 (FRNC—TH-260) AFTERGLOW AND RECOMBINATION IN A LASER PRODUCED PLASMA IN HIGH-PRESSURE He. Sultan, G. (Paris Univ., Orsay (France).) 1971. 171p. (In French). NTIS (U. S. Sales Only).

Thesis.

A plasma produced in He by a laser beam was studied during a period extending from 1 μsec after its creation up until its disappearance. Investigations of the evolution of the plasma radius established the existence of a hydrodynamic region in which the radius may either decrease uniformly or exhibit damped oscillations. The plasma parameters in the equilibrium state were determined: line profiles, electron density, local thermodynamic equilibrium conditions, temperature; density of atoms in the ground state, density of He^+ and He^{++} ions, mean pressure of the plasma. Theoretical and experimental studies were undertaken on collisional radiative recombination with electrons ($He^+ - e - e$) and atoms ($He^+ - e - He$) and also dissociative recombination. The kinetic equations (particularly those of Drawin) give a better description of the experimental results than theories using the Fokker–Planck equation. (France)

16319 (LA-5065) MEGAGAUSS FIELD APPLICATIONS: A SELECTION OF LASL INTERNAL REPORTS. Fowler, C. M. (comp.) (Los Alamos Scientific Lab., N. Mex.). Oct 1972. Contract W-7405-eng-36. 74p. Dep. NTIS.

This document consists of excerpts taken from LASL internal reports dealing with applications of megagauss magnetic fields. Applications include use of megagauss fields as high-pressure sources, as particle accelerators, and as a medium in which the optical properties of a number of materials are investigated. (auth)

16320 (NP-19642) CURRENT DISTRIBUTION IN THE VICINITY OF THE NEUTRAL LINE OF THE MAGNETIC FIELD AND THE TURBULENT PLASMA RESISTIVITY. Syrovatskii, S. I.; Frank, A. G.; Khodzhaev, A. Z. (Akademiya Nauk SSSR, Moscow. Fizicheskii Institut). 1972. 28p. (In Russian). Dep. NTIS (U. S. Sales Only).

The results of an experimental study of the current flow along the neutral line of the quadrupole magnetic field is plasma with density less than 10^{13} cm^{-3} are given. It is shown that the current takes the shape of a sheet with the width exceeding the thickness by a factor of 2 to 2.5. However, it is not the true neutral current sheet, because it changes only weakly the initial magnetic field configuration. The reason is the turbulent nature of plasma conductivity caused by the development of ion-sound instability. To achieve the neutral current sheet it is necessary to increase the plasma conductivity, for instance, by increasing the plasma density. (auth)

16321 (UCID-16169) BEAM RESEARCH PROGRAM: RECENT RESULTS AND STATUS. Beal, J. W.; Briggs, R. J.; Pearlstein, L. D. (California Univ., Livermore. Lawrence Livermore Lab.). Dec 1972. Contract W-7405-eng-48. 47p. Dep. NTIS.

Experimental investigations of the propagation of a bunched beam in a plasma are reported. Theoretical calculations of the propagation are compared with experimental results. The operation of the buncher transport system is described in some detail. (MOW)

16322 INFLUENCE OF MAGNETIC FIELDS ON ANODE LOSSES IN MPD ARCS. Schall, Wolfgang (Institut fuer Plasmadynamik, Stuttgart). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 11: No. 1, 10-11(Jan 1973).

The application of high-magnetic field-strengths in Hall-current accelerators in some cases leads to extremely severe heat losses at the anode. Therefore, the behavior of the anode losses under the variation of magnetic field-strength and shape, background pressure, mass flow rate, and arc current was investigated experimentally. The various origins of the losses (gasdynamic, current transfer, etc.) are identified in order to relate them to more pertinent variables. Finally, an attempt is made to qualitatively explain the observed behavior. (auth)

16323 PRESSURE AND CURRENT EFFECTS ON THE THERMAL EFFICIENCY OF AN MPD ARC USED AS A PLASMA SOURCE. Pivirotto, T. J. (Jet Propulsion Lab., Pasadena, CA). AIAA (Amer. Inst. Aeronaut. Astronaut.) J.; 11: No. 1, 12-13(Jan 1973).

Operation of a magnetoplasmadynamic (MPD) arc without an applied magnetic field is described, and data are presented on its thermal efficiency, principal heat loss, and arc voltage over a range of argon mass flow rates not previously reported and at several arc currents. A comparison between this data and an existing empirical theory is also made with good agreement. (auth)

16324 PLASMA ACCELERATION IN ELECTRIC AND MAGNETIC FIELDS. Manukhina, O. V. Zh. Prikl. Mekh. Tekh. Fiz.; No. 6, 14-17(1972). (In Russian).

The problem of acceleration of a plasma in crossed electric and magnetic fields under the simplest physical conditions, appropriate for comparison with an experiment, is considered. An analytical expression is obtained for the velocity of electrons, the magnitude of the resonance zone of acceleration, and the increase of potential of the accelerated plasma. (tr-auth)

16325 SOME PROBLEMS REGARDING THE BEHAVIOR OF THE POSITIVE COLUMN IN A MAGNETIC FIELD. Toader, E. I. An. Univ. Bucuresti, Fiz.; 18: 117-133(1969). (In Rumanian).

A review is given of research in which the behavior of the positive column in a magnetic field is studied. Both classical results and macroscopic instability phenomenon are discussed. (auth)

Kinetics (Experimental)

16326 CONTRIBUTION OF COULOMB COLLISIONS TO PLASMA RELAXATION IN THE DECA MIRROR MACHINE. Launois, D.; Lecoustey, P.; Tachon, J.; Kesner, J.; Chatelier, M. (CEN, Fontenay-aux-Roses, France). Nucl. Fusion; 12: No. 6, 673-681(Dec 1972).

The relaxation of the ion distribution function was measured for a plasma ($n \simeq 10^{12}$ cm^{-3}, $E_i = 200$ eV) confined in a circularized, stabilized magnetic mirror well. The results were compared with the predictions of a Fokker–Planck computer code. The evolution of an initially skewed angular distribution function appeared to be in good accord with the theoretical model. However, the final anisotropy of the plasma was greater than the calculated one. (auth)

Kinetics (Theoretical)

Refer also to abstract 15674.

16327 (RT/FIMA-(72)5) NUMERICAL SOLUTION OF THE DIRICHLET PROBLEM FOR NONLINEAR ELLIPTIC EQUATIONS. Bittoni, E.; Cenacchi, G.; Mengoli, P.; Taroni, A. (Comitato Nazionale Per L'Energia Nucleare, Rome (Italy)). 1 Sep 1972. 24p. (In Italian). Dep. NTIS (U.S. Sales Only).

Two variants of a numerical method for the solution of the Dirichlet problem for nonlinear elliptic equations in a general region are discussed. Two FORTRAN IV programs based on the given numerical techniques are also described. The equations arise in the study of several physical phenomena, in particular in the study of the equilibrium of a plasma confined in an axially symmetric region. (auth)

16328 (SU-799-X-1) RESEARCH INTO AND USE OF COMPUTER MODELS OF PLASMAS IN CONTROLLED THERMONUCLEAR RESEARCH. Proposal No. IPR-1-73, 1 December 1972–

30 November 1973. (Stanford Univ., Calif. Inst. for Plasma Research). Sep 1972. Contract AT(04-3)-799. 17p. Dep. NTIS.

Current research on simulation of fusion devices is briefly described. Computer experiments are discussed in particular. Summaries are given for the following studies: (1) a propagation experiment with a three-dimensional electromagnetic code which minimizes interpolation effort and proceeds entirely in x, y, z space, (2) optimization of a fast Fourier transform code to permit working in transform space for achieving better quality, (3) comparison of two relativistic Lagrangian particle codes, (4) an electrostatic experiment in log r, θ, z geometry which will be used for toroidal devices, (5) studies of resolution by spline interpolation, (6) optimization of interpolation by means of the variational principle, and (7) experiments with Eulerian codes. (MOW)

16329 (TRITA-EPP-72-25) ASSERTION THAT ALL RECTANGLES ARE SQUARE OR A CRITICAL REVIEW OF SOME METHODS OF PROOF GENERALLY ACCEPTED IN THE KINETIC THEORY OF GASES AND PLASMAS. Dahlberg, E. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Nov 1972. 37p. Dep. NTIS (U. S. Sales Only).

In opposition to many authors on kinetic theory, it is maintained that the unspecified relation $dc_1' dc_2' = dc_1 dc_2$, between initial and final velocities in a binary collision, as used by them in the derivation of Boltzmann's collision term, is false and, in fact, equivalent e.g., to all rectangles being square. The introduction of this false assertion forces its users to imply or state a second false assertion to reconnect the chain of argument. In this note four derivations are sketched, which although not necessarily longer than those commonly given, are principally comprehensible. Some malpractices that have become widespread in gas-kinetic texts are discussed. (auth)

16330 REFLECTIONS FROM A PLASMA SPHERE AND RELATIONSHIP BETWEEN PLASMA FREQUENCY AND THE CLASSICAL ELECTRON RADIUS. Hershberger, W. D. (Univ. of California, Los Angeles). J. Appl. Phys.; 43: No. 12, 5204-5(Dec 1972).

Plasma frequency, ω_p, may be expressed in terms of the classical electron radius r_e by the relationship: $\omega_p^2 = 4\pi c^2 N r_e$. The use of this relationship permits the reflection cross section of a spherical cluster of electrons to be expressed in terms of electron radius, when this is convenient, or alternately, in terms of macroscopic quantities such as plasma frequency and the radius of the electron cluster. (auth)

16331 DENSITY-MATRIX METHOD FOR A WEAKLY IONIZED PLASMA. Fisher, D. M.; Willett, J. E. (Univ. of Missouri, Columbia). J. Appl. Phys.; 43: No. 12, 5196-5200(Dec 1972).

A density-matrix formalism for a system consisting of dynamically independent electrons interacting with random scattering centers and arbitrary electromagnetic fields is considered. The method of deriving the equation of motion for the density matrix averaged over scatterer positions is generalized to apply to any order in the electron-field interaction. A solution of the linearized equation of motion is employed to determine the power absorbed by a weakly ionized plasma with a realistic electron–neutral-atom interaction. In an approximation in which the neutral atoms do not change states, results similar to those obtained using a simple potential approximation are derived. (auth)

16332 MODIFIED HYPERNETTED-CHAIN EQUATION FOR THE SCREENED COULOMB POTENTIAL. Cooper, M. S. (Univ. of California, Berkeley). Phys. Rev., A; 7: No. 1, 1-4(Jan 1973).

A modified form of the hypernetted-chain (HNC) equation is found that is suitable for the calculation of the pair-correlation function of a classical plasma. The changed equation involves only the short-range screened Coulomb potential and uses no further approximations than are involved in the ordinary HNC equation. The pair-correlation function is computed for a variety of one-component classical plasmas in the region of a dense fluid. (auth)

16333 · DISPERSION RELATION FOR CHERENKOV RADIATION OF MOVING TEST PARTICLES IN A MAGNETOPLASMA. Suh, P. K.; Ericson, W. (Grumman Aircraft Engineering Corp., Bethpage, NY). Plasma Phys.; 14: No. 11, 981-998(Nov 1972).

The general radiative criteria for the Cherenkov spectrum emitted from moving test particles in a magnetoplasma are investigated by analyzing the radiative dispersion relation. The radiative criteria are given in explicit forms that are readily adaptable to the calculation of radiations emitted from various test particles. The results of the analysis have a bearing on a number of astrophysical and terrestrial problems as well as on the laboratory determination of the test-particle properties. (auth)

16334 SYMMETRY PROPERTIES OF NONLINEAR RESPONSES IN A PLASMA. Melrose, D. B. (Australian National Univ., Canberra). Plasma Phys.; 14: No. 11, 1035-1046(Nov 1972).

The symmetry properties of tensors describing the nonlinear responses of a collisionless magnetoactive plasma are discussed, concentrating on the generalization of the Onsager relations. It is found that the tensor describing the relation between the induced current and a product of n vector potentials changes sign under reversal of the signs of the frequencies and of the sense of the background magnetic field, and is completely symmetric under permutations of the indices with associated permutations of the arguments. (auth)

16335 CORRIGENDUM AND ADDENDUM TO "RAYLEIGH'S PROBLEM IN COLLISIONLESS PLASMAS." Chang, T. S.; Chang, C. M. (North Carolina State Univ., Raleigh). Plasma Phys.; 14: No. 11, 1061(Nov 1972).

It is pointed out that previous results (Chang and Chang, 1971; NSA 26: 3011) are strictly true only during the initial period of motion when "collisions" and collective interactions through the perturbed fields can be neglected. During this period, equation (1) of the paper is automatically linearized without the further assumption of small deviations from the initial state. The first term of equation (31), which contained an integration error, and the corresponding terms in the subsequent expressions can be deleted, allowing the perturbed distribution function to be written in a more compact form. (UK)

16336 REMARKS ON VARIATIONAL PRINCIPLE FOR AN INVISCID, PERFECT, MAGNETIZED PLASMA. Ito, H. (Osaka Univ.). Progr. Theor. Phys. (Kyoto); 48: No. 5, 1442-1450(Nov 1972).

A variational calculation for the motion of a compressible, inviscid, magnetized plasma with infinite conductivity is expounded. The model for the calculation is essentially based on a theory of two fluids consisting of ions and electrons of the same number. For the mean velocity of these two components, the usual magnetohydrodynamical equation of motion is obtained. The equation of the current variation is derived for their relative velocity. From this calculus of variation, using an appropriate Lagrangian, a generalized London equation in the theory of superconductors is directly obtained. The behavior of the vorticity of this magnetized fluid is the same as that of usual ideal fluids. The frozen-in condition of the magnetic field into the plasma with infinite conductivity is closely related to the vorticity condition. (auth)

16337 COLLISIONAL–RADIATIVE COEFFICIENTS AND POPULATION COEFFICIENTS ON HYDROGEN PLASMA. Fujimoto, Takashi; Sugiyama, Ikuto; Fukuda, Kuniya (Kyoto Univ.). Mem. Fac. Eng., Kyoto Univ.; 34: No. 2, 249-277(Apr 1972).

Numerical calculation based on the collisional–radiative model is made for rate equations of optically thin hydrogen plasma to give the collisional–radiative and population coefficients. Results are tabulated for the range of plasma parameters of $1 \times 10^3 \leq T_e \leq 2.56 \times 10^5$ °K and $10^6 \leq n_e \leq 10^{20}$ cm^{-3}. Behavior of all the coefficients is analyzed as a function of electron density, and as a result, the asymptotic expressions of the coefficients at low and high electron-density limits as well as the approximate expressions of the critical electron densities for these asymptotic behaviors are obtained in terms of the rate coefficients for atomic transitions. Effect of trapping of resonance radiations on the coefficients is discussed. (auth)

16338 SOME REMARKS ON THE DEBYE SHIELDING DISTANCE. Demchenko, V. V.; Hussein, A. M. (Atomic Energy Authority, Cairo). Phys. Lett., A; 42A: No. 5, 379-380(1 Jan 1973).

An improvement of the theory of Debye shielding in a plasma was attempted. It was demonstrated that the distribution of a self-consistent field, theoretically predicted through linearization over the field amplitude, might essentially differ from the field distribution yielded by improved (nonlinear) assumptions. (auth)

16339 RADIATIVE AND COLLISIONAL EFFECTS IN A CYLINDRICALLY CONFINED PLASMA. 1. OPTICALLY THIN CONSIDERATIONS. Giannaris, R. J.; Incropera, F. P. (Purdue Univ., Lafayette, IN). J. Quant. Spectrosc. Radiative Transfer; 13: No. 2, 167-181(Feb 1973).

A rigorous model was formulated to determine the effect of collisional and radiative processes on electronic state populations in a cylindrically confined plasma. The model was solved for an atmospheric argon arc plasma assuming optically thin conditions for all but the resonance line radiation, which is allowed to be optically thick. From parametric calculations and comparisons with experiment, the relative effects of the

various processes on excitation conditions were delineated and the nature and degree of excitation nonequilibrium were determined. (auth)

16340 RADIATIVE AND COLLISIONAL EFFECTS IN A CYLINDRICALLY CONFINED PLASMA. 2. ABSORPTION EFFECTS. Giannaris, R. J.; Incropera, F. P. (Purdue Univ., Lafayette, IN). J. Quant. Spectrosc. Radiative Transfer; 13: No. 2, 183-195(Feb 1973).

A comprehensive model was developed for radiation emission and absorption in cylindrically confined plasmas, and calculations were performed for the asymptotic region of an argon arc plasma. Radiation absorption is shown, in general, to have a negligible effect on bound level populations. The exception is for the near wall region of the 35 A arc, for which self-absorption in the lines of the 4s – 4p array has a significant effect. For the 4s – 4p array, absorption also significantly reduces the radiation flux to the constrictor wall. (auth)

16341 COMPARISON OF EXACT AND MEAN BEAM LENGTH RESULTS FOR A RADIATING HYDROGEN PLASMA. Mandell, D. A.; Miller, F. A. (Washington State Univ., Pullman). J. Quant. Spectrosc. Radiative Transfer; 13: No. 1, 49-56(Jan 1973).

Accuracy of the mean-beam-length technique in high-temperature radiative heat transfer, combined with other modes of heat transfer, was investigated. In order to study the validity of the method, Nusselt numbers are presented for fully developed channel flow of a radiating nonisothermal hydrogen plasma. Black isothermal boundaries are considered. Numerical results obtained from the exact integro-differential equation have been obtained previously for this problem. Linearized radiation and local thermodynamic equilibrium are assumed. The results show that the Nusselt numbers obtained by using the geometric mean beam length are in close agreement with results obtained by using the mean beam length. Therefore, the complicated calculations needed to obtain the mean beam length are unnecessary. A comparison of the results with previously reported work shows that the mean-beam-length technique is a better approximation to the exact solution than the optically thin, optically thick, or nongray differential approximation solutions. (auth)

16342 CONCERNING THE ACCURACY OF CONSERVATION OF THE THIRD ADIABATIC INVARIANT OF THE MOTION OF A CHARGED PARTICLE IN AXISYMMETRIC FIELDS. I. Bogdanov, V. V.; Pletnev, V. D. Cosmic Res. (USSR) (Engl. Transl.); 10: No. 3, 324-32(1972).

Translated from Kosm. Issled.; 10: No. 3, 358-67(1972).

A possible mechanism for violation of the third adiabatic invariant in an axisymmetric magnetic field is considered. It is proved that the condition of conservation of the third invariant is formulated in conventional form — namely, as the requirement of adiabaticity of field variation, and that it is not exclusively associated with the symmetry of the field. The invariant coupling between the radius-vector and the velocity of the charged particle in symmetrical fields is found. (auth)

16343 SOLUTION OF TROESCH'S TWO-POINT BOUNDARY-VALUE PROBLEM BY A COMBINATION OF TECHNIQUES. Roberts, S. M. (IBM, Palo Alto, Calif.); Shipman, J. S. J. Comput. Phys.; 10: No. 2, 232-41(Oct 1972).

Troesch's problem, which arose in the investigation of the confinement of a plasma column by radiation pressure, is an inherently unstable two-point boundary value problem. This paper discusses how Troesch's problem may be solved by a combination of methods, multipoint, continuation, and perturbation, although none of these methods by itself is sufficiently potent. (auth)

Production

16344 (AD-747681) NUCLEAR-GENERATED PLASMAS. Final Summary Technical Report, May 1, 1965–June 30, 1971. Ellis, W. H. (Florida Univ., Gainesville. Dept. of Nuclear Engineering Sciences). 8 Sep 1971. Contract Nonr-580(18). 410p. NTIS.

The report presents a survey of the research activities of a Graduate Research program in the area of nuclear generation of plasmas for potential application to MHD electrical power generation from nuclear energy sources. Described are the development of a new plasma diagnostic tool, the pulsed ionization chamber (PIC), its application to plasma kinetic measurements in high pressure gases of the type and in the pressure range used for nuclear reactor coolants and MHD working media and to wide-range neutron flux and reactor power measurements (over a range of 10 orders of magnitude). (auth)

16345 FUTURE ICE (THERMONUCLEAR, THAT IS). Teller, E. (Univ. of California, Livermore). IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 1, 60-64(Jan 1973).

A brief general discussion of plasma problems in controlled fusion is given; particularly, compression of solid particles by high-powered laser beams is discussed. (MOW)

16346 ELECTRO-OPTICAL SHUTTER WITH SYNCHRONIZATION BY LASER RADIATION. Sklizkov, G. V.; Fedotov, S. I. (Inst. of Physics, Moscow). Instrum. Exp. Tech. (USSR) (Engl. Transl.); 15: No. 2, 512-514(1972).

Translated from Prib. Tekh. Eksp.; 15: No. 2, 176-178(1972).

An electro-optical shutter with synchronization by a laser beam is described which is used for the formation of short light pulses having a length 4×10^{-10} to 10^{-8} sec. The results of investigating the time delay of the instant at which the shutter operates as a function of the energy of the initiating laser radiation are presented. (auth)

Stability

16347 (AD-743886) ION-ION INSTABILITY INDUCED BY A.C. ELECTRIC FIELDS. Papadopoulos, K.; McBride, J. B. (Naval Research Lab., Washington, D. C.). Jun 1972. 15p. (NRL-MR-2448). NTIS.

The presence of low-frequency ac fields in a plasma substantially modifies the marginal stability condition for a counter-streaming ion–ion instability and allows the system to be unstable even if the electron thermal energy is much smaller than the relative ion streaming energy. The possible role of the instability in high Mach number whistler shocks is discussed. (auth)

16348 (COO-1478-13) MICROINSTABILITIES IN INHOMOGENEOUS PLASMA. Progress report, January 31, 1972–January 31, 1973. Kammash, T. (Michigan Univ., Ann Arbor. Dept. of Nuclear Engineering.). Jan 1973. Contract AT(11-1)-1478. 6p. Dep. NTIS.

Summaries are given of research topics during this contract period: (1) two-dimensional investigation of absolute instabilities of mirror plasmas, (2) beam–plasma interaction in Astron, (3) energy loss of charged particles in Maxwellian plasma, (4) slowing down of relativistic electrons in plasma, (5) anomalously confined Tokamak reactor, and (6) alpha particle heating of mirror plasmas. (MOW)

16349 (FRNC—TH-259) ION INSTABILITIES IN THE PRESENCE OF AN INTENSE h-f ELECTROMAGNETIC FIELD. Moisan, M. (Paris Univ., Orsay (France).) 1971. 191p. (In French). NTIS (U. S. Sales Only).

Thesis.

A type of autoresonant hf plasma is presented, which enables the mean electron plasma frequency $f_{mean\ ep}$ to be accurately measured at the position where an instability is formed, thus favoring the determination of the relation linking the frequency of the external field f_0 to f_{ep} in the presence of this instability. It was possible to identify more than 8 ion instabilities and it was shown that all these oscillations appear in two types of region: the first type when $sf_0 = f_{mean\ ep}$ and the second type when $sf_0 = f_{mean\ ep}/\sqrt{2}$. These regions correspond respectively to the excitation of a volume electron wave and to the propagation of a surface electron wave. The latter type was studied in detail. It was observed that unstable oscillations do not occur at the ion plasma frequency even when the wave length exceeds the Debye length. This fact agrees with the Silin theory. (France)

16350 (ORNL-TM-4077) INTERCHANGE STABILITY OF A GUIDING-CENTER PLASMA IN AN AXISYMMETRIC MAGNETIC TRAP. Guest, G. E.; Hedrick, C. L.; Nelson, D. B. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 29p. Dep. NTIS.

The derivation and evaluation of criteria for stability of interchange modes in axisymmetric equilibria of anisotropic, guiding-center plasmas are presented. The present case thus involves two important simplifying restrictions: (i) Because of the assumed symmetry one can use an orthogonal curvilinear coordinate system based on the magnetic field lines, the so-called ψ, θ, χ coordinates. The properties of this reference frame are summarized. (ii) Because of the restriction to interchange modes, one can obtain useful stability criteria without solving the full Euler–Lagrange minimization problem. Here, interchanges are defined to be perturbations that leave the shape of magnetic field lines unchanged; that is, the perturbed magnetic field is parallel to the equilibrium field. Since closely related criteria have been derived earlier for scalar pressure plasmas (in closed-line devices), a brief derivation of the scalar-pressure criterion is

given, and its correspondence with the present guiding-center criteria is discussed. (auth)

16351 (TRITA-EPP-72-23) BASIC FEATURES OF PLASMA INSTABILITIES. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). 22 Oct 1972. 229p. Dep. NTIS (U. S. Sales Only).

A review is given on the present state of research on plasma instabilities: (1). The basic characteristics of various instability phenomena known so far are outlined, including the methods of the underlying analysis, the general physical properties of unstable modes, the corresponding energy sources and coupling mechanisms, as well as applied stabilization methods. (2). A classification scheme is developed for a systematic subdivision of existing types of plasma disturbances, including both stable and unstable modes. In addition, a general description is given of each instability mode being detected so far. (3). The present state of research on plasma instabilities is summarized, including discussions both on linear and nonlinear modes and on associated loss mechanisms. (4). The established classification scheme is applied in a systematic search for instability phenomena which so far have remained undiscovered. (auth)

16352 (UUIP-755) NUMERICAL INVESTIGATION OF COLLISION INDUCED PLASMA INSTABILITIES. Ring, R. (Uppsala Univ. (Sweden). Inst. of Physics). Dec 1971. 26p. (In Swedish). Dep. NTIS (U. S. Sales Only).

A homogeneous plasma in a constant external electric field was investigated. A collisional term permitting loss of momentum and energy was used. Conditions of stability for long electromagnetic waves were derived. These conditions were controlled by numerical calculations. It was shown that electrostatic, short wave perturbations may cause instabilities in plasmas which are stable for long wave perturbations. (GN)

16353 DRIFT INSTABILITIES IN NONUNIFORM STREAMING PLASMAS. Buti, B. (Physical Research Lab., Ahmedabad, India); Lakhina, G. S. Phys. Rev., A; 7: No. 1, 319-327(Jan 1973).

The stability of electromagnetic waves propagating transverse to the direction of streaming in a system comprised of identical nonuniform plasmas contrastreaming along a nonuniform magnetic field is investigated. It is found that the low-frequency waves $\omega^2 \ll \Omega_i^2$ (ω and Ω_i being the wave frequency and the ion cyclotron frequency, respectively) can become unstable due to the excitation of either resonant ion instability or resonant electron instability. The latter instability can be excited only in the presence of streaming. The drift cyclotron instability gets excited for some bounded values of U_e, U_i, k, β, and μ (U_e being the electron streaming velocity, U_i the ion streaming velocity, k the characteristic wave number, β the ratio of kinetic pressure to magnetic pressure, and μ the inhomogeneity in the magnetic field). The effect of ion temperature on this mode is stabilizing and the typical growth rates associated with this unstable mode are of the order of Ω_i. The presence of even a weak inhomogeneity can render the otherwise marginally stable waves unstable, their growth rates being as high as 0.05 Ω_e (Ω_e being the electron cyclotron frequency). However, the effect of μ and ∇n on the transversal instability (for frequencies $\Omega_i^2 \ll \omega^2 \ll \Omega_e^2$) is to increase the growth rate of the unstable waves slightly. (auth)

16354 PHASE-SPACE EVOLUTION OF A TRAPPED ELECTRON BEAM. Gentle, K. W.; Lohr, J. (Univ. of Texas, Austin). Phys. Rev. Lett.; 30: No. 3, 75-7(15 Jan 1973).

The nonlinear development of the instability excited by a cold, weak electron beam injected into a one-dimensional plasma is examined with a fast electron velocity analyzer. The distribution of the electrons in phase space is observed as the instability grows, traps the beam, and oscillates. The observed distributions mirror those first seen in computer simulations which lead to the trapping hypothesis. (auth)

16355 NONLINEAR STABILIZATION OF $\vec{E} \times \vec{B}$ ELECTRON DRIFT INSTABILITY WITH $T_i \sim T_e$. Rogister, A. (European Space Research Inst., Frascati, Italy). Phys. Rev. Lett.; 30: No. 3, 86-9(15 Jan 1973).

The resonant nonlinear interactions of two waves with the gyromotion of the electrons stabilize the high-frequency modes of the $\vec{E} \times \vec{B}$ electron drift instability, but further destabilize the low-frequency modes. However, the total wave energy is stabilized by this mechanism, whereas wave–wave scattering processes transfer energy from the unstable region of the spectrum toward the nonlinearly damped one. The predicted turbulence level at $K = 1/\lambda_D$ is in good agreement with experimental results. (auth)

16356 STABILITY OF A TOKAMAK WITH A NON-ROUND PLASMA-LOOP CROSS SECTION. Solov'ev, L. S. JETP Lett. (USSR) (Engl. Transl.); 16: No. 7, 298-300(5 Oct 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 7, 420-3(5 Oct 1972).

The destabilizing factors responsible for the hydromagnetic instability of tokamak plasmas are the pressure gradient and the longitudinal current in the plasma torus, and the stability conditions impose limitations on both of these quantities. The conditions of local stability for conditions in which the plasma pressure away from the magnetic axis decreases turns out to be the most critical in the vicinity of the magnetic axis. The necessary and sufficient stability criteria for these systems are discussed. (MOW)

16357 EFFECT OF ION VISCOSITY AND THERMAL CONDUCTIVITY ON THE DRIFT INSTABILITY IN AN INHOMOGENEOUS HIGH-PRESSURE COLLISIONAL PLASMA. Nemov, V. V. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 12: No. 6, 643-648(Dec 1972).

Applying a magnetohydrodynamic description of a plasma, a theoretical study is carried out on the effect of ion viscosity and thermal conductivity on the drift instability in an inhomogeneous plasma with large β and $k_z \neq 0(\beta = 8\pi p/B^2$, k_Z is the component of the wave vector along the unperturbed magnetic field). It is shown that, if the particle collision frequency is low enough, ion viscosity and thermal conductivity may be the cause of instability. (auth)

16358 INSTABILITY OF A PINCH SURROUNDED BY A RESISTIVE WALL. Goedbloed, J. P. (FOM-Instituut voor Plasmafysica, Rijnhuizen, Netherlands); Pfirsch, D.; Tasso, H. Nucl. Fusion; 12: No. 6, 649-657(Dec 1972).

A pinch configuration which is stabilized by the flow of force-free currents in the outer region and by the presence of an ideally conducting wall becomes unstable if the wall is made slightly resistive. Growth rates for the instability are derived, and it is shown that this instability need not be a limiting factor for thermonuclear experiments, provided that the equilibrium parameters are carefully chosen and that it is possible to operate at the usual high pinch densities. Limitations do arise if the plasma density is reduced. (auth)

16359 ENERGY-BALANCE INSTABILITIES IN FUSION PLASMAS. Powell, C.; Hahn, O. J. (Univ. of Kentucky, Lexington). Nucl. Fusion; 12: No. 6, 667-672(Dec 1972).

The stability of the energy balance in a fusion plasma is studied. We consider a uniform plasma, confined by a uniform magnetic field that does not penetrate the plasma. There is no energy input from external sources to the plasma or to the field coils, and no resistive losses in the coils. All species are assumed to have Maxwellian distributions at a common temperature. A set of particle-conservation equations are written, one for each ionic species, and two energy-balance equations, one for the plasma and one for the plasma plus the field. Thus the energy balance is described by a set of nonlinear first-order differential equations. For steady state, these become algebraic equations, which can be solved numerically to determine the equilibrium states of the plasma. For small departures from equilibrium, the differential equations can be linearized. The linearized equations can be solved by the Laplace transform, and a stability condition can be obtained. However, this procedure involves some rather complicated algebra. (auth)

16360 TIME EVOLUTION AND FUNCTIONAL FORM OF MAGNETOSTATIC EQUILIBRIA IN AXISYMMETRY. Misguich, J. H.; Declercq, G. (CEN, Fontenay-aux-Roses, France). Plasma Phys.; 14: No. 11, 975-979(Nov 1972).

The evolution of an axisymmetric magnetic field is studied and it is shown that a relation can be found between the physical properties and the functional form of the equilibria. More precisely, it is demonstrated that the only nontrivial magnetostatic equilibria, where the resistivity can be considered as constant, belong to the linear class. This simple mathematical class thus appears to be the only one possible under some simple physical conditions. Furthermore, it is shown that an axisymmetric equilibrium with parallel magnetic surfaces can only exist in a force-free medium, excluding the obvious case of cylindrical symmetry. (auth)

16361 ELECTROMAGNETIC LOSS-CONE INSTABILITY OF A PLASMA. Stepanov, K. N. (Physical-Technical Inst., Kharkov); Egorenkov, V. D. Phys. Lett., A; 42A: No. 5, 355-356 (1 Jan 1973).

The instability is considered of a plasma with nonmonotonous ion velocity distribution function in the plane transverse to the magnetic field. It is shown that in the finite pressure plasma with $\beta = 4\pi n\langle v_\perp^2\rangle/B_0^2$ the electromagnetic waves of the whistler type appear to be unstable. The growth rate of the whistlers is determined for the large ion thermal velocity spread when the excitation is

due to resonant ions. The growth rate of whistlers is at maximum $\gamma \sim (\omega_{Be}\omega_{Bi}/\beta)^{\frac{1}{2}}$ when $kc \sim \omega_{pe}$ and $\omega \sim kv_{Ti}$. (auth)

16362 SATURATION OF THE RELATIVISTIC BEAM–PLASMA INSTABILITY FOR ARBITRARY DENSITY RATIOS. Toepfer, A. J.; Poukey, J. W. (Sandia Labs., Albuquerque, NM). Phys. Lett., A; 42A: No. 5, 383-384(1 Jan 1973).

The nonlinear saturation level W_s of the one-dimensional beam–plasma instability was calculated as a function of beam energy γ_0 for all values of beam/plasma density ratio η. For $\eta \geq 0.01$, W_s decreases with increasing γ_0. (auth)

16363 SUPPRESSION OF CYCLOTRON PLASMA INSTABILITY BY MEANS OF A MODULATED ELECTRON BEAM. Karkhov, A. N. At. Energ. (USSR); 34: No. 1, 46-47(Jan 1973). (In Russian).

It is proposed to use an electron beam, modulated with respect to density, to suppress a cyclotron instability. It had already been demonstrated that cyclotron instability can be suppressed by heating electrons with microwaves, and that density thresholds exist above which electron Landau damping becomes too weak to suppress the instability. The electron beam in this case must be admitted along the external magnetic field and controlled by a feedback system. It is essential to select the particle velocity and the modulation of the beam so that the beam electrons compensate the splitting of charges that arise as a result of instability. (KSW).

Thermonuclear Engineering and Equipment

Refer also to abstracts 16025 and 16032.

16364 (BNWL–1685) PACIFIC NORTHWEST LABORATORY ANNUAL REPORT ON CONTROLLED THERMONUCLEAR REACTOR TECHNOLOGY, 1972. Wolkenhauer, W. C. (ed.) (Battelle Pacific Northwest Labs., Richland, Wash.). Nov 1972. Contract AT(45-1)-1830. 152p. Dep. NTIS.

Separate abstracts were prepared for ten sections. (MOW)

For abstracts of individual sections see: 16032 and 16365–16373.

16365 (BNWL–1685, pp 8-17) FUSION-FISSION (HYBRID) SYSTEMS. Leonard, B. R. Jr.; Wolkenhauer, W. C. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

The following aspects of a hybrid fusion–fission power plant are briefly discussed: (1) economics, (2) environmental quality, (3) resource preservation, and (4) strategy for research and development. (MOW)

16366 (BNWL–1685, pp 18-32) HYBRID NEUTRONICS ANALYSIS. Leonard, B. R. Jr. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

The studies of hybrid systems were designed to explore the objective of the optimization of power multiplication with a subcritical fission lattice. The lattice studied was a niobium-clad, natural-uranium, graphite-moderated, helium-cooled lattice with 7-inch pitch. An isotropic 14-MeV neutron source was defined to be uniformly distributed in a cylindrical thermonuclear plasma of 160-cm radius. The neutronics problem is the calculation of the reaction rate per source neutron of all the neutron-induced reactions throughout the blanket. The calculations are described. (MOW)

16367 (BNWL–1685, pp 33-52) CONTROLLED THERMONUCLEAR REACTOR AS A FISSION PRODUCT BURNER. Wolkenhauer, W. C. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

The USAEC and other agencies are vitally interested in finding acceptable means of storage or elimination of the large quantities of fission products that are expected to exist in the latter part of the twentieth century. Announced plans call for the permanent storage of these radioactive wastes in deep salt mines. Several alternate storage concepts are being explored. Some of these include storage in bedrock or basalt formations under federal reservations. Other long-range storage proposals being considered include burial in a nuclear chimney and burial in polar ice caps. Possible long-range alternatives for elimination of the fission products from the biosphere include extraterrestrial disposal and nuclear transmutation. Some aspects of this option are discussed. (auth)

16368 (BNWL–1685, pp 53-74) CALCULATION OF THE CONTROLLED THERMONUCLEAR STANDARD BLANKET AS ESTABLISHED BY THE ORNL WORKING SESSION NEUTRONICS COMMITTEE; PHASES I AND II. Prezbindowski, D. L. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

With the increasing success observed in controlled thermonuclear experiments, scientists and engineers are beginning to turn their attention toward the engineering problems of designing and building controlled thermonuclear power plants. The most likely first-generation controlled thermonuclear reactor (CTR) will operate on the deuterium–tritium fuel cycle in which most of the useful energy from the reaction is given off as an energetic (14.1 MeV) neutron. Moreover, this neutron must be used to breed tritium from lithium to continue the reaction as tritium is not available in nature. Therefore, it is most important that scientists and engineers interested in CTR technology have a good grasp of the physics of 14.1-MeV neutrons. (auth)

16369 (BNWL–1685, pp 93-98) ECONOMIC REGIME FOR FUSION REACTORS. Deonigi, D. E.; Engel, R. L.; Young, J. R. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

An exploratory study was made to determine the electricity cost for the barely competitive fusion reactor late in this century and early in the next century. A primary purpose of the effort was to explore the calculational methods to determine the feasibility of the selected approach. (auth)

16370 (BNWL–1685, pp 99-106) GRAPHITE FOR CONTROLLED THERMONUCLEAR REACTORS. Tingey, G. L. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

The environment of Controlled Thermonuclear Reactors (CTR) places stringent temperature and radiation requirements on core materials. Most current CTR conceptual designs include graphite as one of the candidate materials. Although there are major problems in the use of graphite, its characteristic properties such as high-temperature stability, low neutron-capture cross section, and moderating ability make it the foremost candidate for the moderator, the reflector, and shielding of CTR. In fact, some have suggested its use for other applications, including the vacuum wall. (auth)

16371 (BNWL–1685, pp 107-111) HYDROGEN ISOTOPES EFFECTS; SOLUBILITY AND DIFFUSIVITY OF HYDROGEN ISOTOPES IN CANDIDATE CTR WALL METALS. Johnson, A. B. Jr.; Charlot, L. A.; Westerman, R. E. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

A vacuum system was built so that the solubility and diffusitivity of hydrogen isotopes, principally tritium, in candidate CTR metals can be determined at metal temperatures to 1000°C and gas overpressures from 100 torr down to 10^{-3} torr. The metals studied were Nb, V, and Nb1–Zr. (MOW)

16372 (BNWL–1685, pp 114-124) CTR VACUUM WALL SPUTTERING AND WALL LIFE CRITERIA. Laegried, N.; Dahlgren, S. D. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

General equations are presented that are easily used for estimating erosion rates and wall life. Specifically these have been applied to wall materials proposed for conceptual pulsed and steady-state (mirror and toroidal) experimental reactors. Sputtering factors applicable to CTR vacuum wall erosion are also discussed. (MOW)

16373 (BNWL–1685, pp 125-141) IRRADIATION INDUCED SWELLING IN CTR MATERIALS. Brimhall, J. L. Nov 1972.

In Pacific Northwest Laboratory annual report on controlled thermonuclear reactor technology, 1972.

A detailed study of the void swelling phenomena in ion bombarded niobium and Nb–1% Zr alloy is described. The specimens were prepared in the form of foils 0.05- to 0.2-mm thick. All material was annealed at 1600°C for approximately 30 minutes in a vacuum of 10^{-7} torr. After annealing, the surfaces were electropolished. The specimens were irradiated by 7.5-MeV Ta^{3+} ions. The microstructure of the irradiated specimens is discussed. (MOW)

16374 (CLM-R-120) SHIELDING OF SUPERCONDUCTING MAGNETS IN A FUSION REACTOR. McCracken, G. M.; Blow, S. (United Kingdom Atomic Energy Authority, Abingdon (England).

Culham Lab.). Aug 1972. 10p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

The effect of radiation damage on the current density which a superconducting composite can carry is discussed, considering damage in the superconductor itself and in the normal conductor used for stabilization and protection. The maximum fast neutron fluence that can be sustained for a 10% reduction in current density was estimated to be $\sim 10^{18}$ n cm^{-2} for the superconductor and $\sim 10^{17}$ n cm^{-2} for the normal conductor. Using results from Monte Carlo computations of the neutron flux reduction per unit thickness of shield, the shield thickness required to meet the above criteria was calculated as a function of reactor wall loading, and these results compared with those calculated on purely thermal criteria. (auth)

16375 (MATT-947) TOWARDS FUSION REACTOR IGNITION; THE ADIABATIC TOROIDAL COMPRESSION SYSTEM. Citrolo, J. C. (Princeton Univ., N. J. Plasma Physics Lab). Dec 1972. Contract AT(11-1)-3073. 6p. Dep. NTIS.

A major problem area in the study of the feasibility of fusion reactors is the attainment of hot dense plasma for experimental study and the determination of a heating scheme to reach ignition conditions in a reactor. Adiabatic compression in minor and major radius of Tokamak configuration plasmas was proposed as a means of reaching this end. The Adiabatic Toroidal Compressor (ATC) was built at the Princeton Plasma Physics Laboratory to determine experimentally the feasibility of this technique. This paper describes the engineering features of this machine. Preliminary results indicate that compression heating is a possible method of assisting reaching fusion ignition temperatures. (auth)

16376 (NP-19643) WILLS PLASMA PHYSICS DEPARTMENT TWENTY-FOURTH SIX-MONTHLY PROGRESS REPORT, 1st JULY-31st DECEMBER 1972. (Sydney Univ. (Australia). School of Physics). 1972. 10p. (PR-24). Dep. NTIS (U. S. Sales Only).

Summaries are given of experimental progress in plasma sources, hydromagnetic shock waves, rotating plasmas, ion cyclotrons, cyclotron harmonic waves, far-infrared, atmospheric pollution and laser diagnostics. (Australia)

16377 LASER-DRIVEN IMPLOSION OF SPHERICAL DT TARGETS TO THERMONUCLEAR BURN CONDITIONS. Clarke, J. S.; Fisher, H. N.; Mason, R. J. (Los Alamos Scientific Lab., NM). Phys. Rev. Lett.; 30: No. 3, 89-92(15 Jan 1973).

Calculations predict that carefully timed laser pulses can implode small DT spheres and shells to extreme densities such that thermonuclear burn ensues. The implosion quality is characterized as a function of the pulse time scale, growth law, and initial intensity. Phenomenological rules for mass scaling, input energy threshold, and yield ratio $Y_R = E_{out}/E_{in}$ are presented. One finds that $Y_R = 4.7$ for only 1.9 kJ of CO_2 laser input energy to a 3-μg shell. The performance of shells is compared to spheres. (auth)

16378 ELECTRON BEAM FOCUSING USING CURRENT-CARRYING PLASMAS IN HIGH-ν/γ DIODES. Yonas, G.; Prestwich, K. R.; Poukey, J. W.; Freeman, J. R. (Sandia Labs., Albuquerque, NM). Phys. Rev. Lett.; 30: No. 5, 164-167(29 Jan 1973).

A technique was demonstrated for concentrating electron beams to 5×10^6 A/cm^2 plasmas on the axis of diodes. A two-dimensional particle code was used to illustrate the importance of both the $\vec{E} \times \vec{B}$ motion in vacuum and the self-pinch of the beam within the plasma. (auth)

16379 EXISTENCE OF A BOOTSTRAP CURRENT IN A STELLARATOR. Pfirsch, D. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 12: No. 6, 728-729(Dec 1972).

Some brief arguments are given against the existence of bootstrap currents in stellarators. References are made in particular to magnetohydrodynamic theory and collisional regimes. (MOW)

16380 FIRST-WALL EROSION IN FUSION REACTORS. Behrisch, R. (Oak Ridge National Lab., TN). Nucl. Fusion; 12: No. 6, 695-713(Dec 1972).

The subject of sputtering by ions and neutrons was reviewed, and yields for various ions on Nb in the energy range of 100 eV to 100 keV were assembled. Furthermore, evaporation rates of Nb for stationary conditions and for short time energy pulses are calculated, and a brief summary is given of the blistering phenomena. For a tokamak or stellarator-type CTR first-wall bombardment is estimated from the α-energy released in the plasma. First-wall-erosion data as well as the flux of sputtered and evaporated Nb-atoms back to the plasma are calculated for two CTR reactors with a difference of a factor of 10 in first-wall load. It is shown that sputtering can account for wall deterioration at a rate of more than 1 mm per year. (auth)

16381 ENERGY IN THE FUTURE: THE ROLE OF NUCLEAR FISSION AND FUSION. Lewis, W. B. (Proc. Roy. Soc. Edinburgh, Sect. A; 70: 219-23(1972).

For comfort the total future world population faces a limit. Three or more educated generations seem likely before the population growth will be checked. It seems prudent to envisage a world population of about 15 thousand million in a century or two. Their energy needs for food, water, warmth, clean air, locomotion and management of wastes may be assessed at 5 to 50 thermal kilowatts per capita. That amounts to 0.05 to 0.5% of the energy supply from the sun. Generating this amount of nuclear fission would cause no severe pressure on world resources of uranium and thorium for hundreds of centuries, if near breeders such as CANDU reactors are used exploiting the uranium-thorium fuel cycle. Neither the cost of fuel supply nor of waste management to keep the environment unburdened by extra radioactivity need be as high as prices now paid for coal and oil. The addition of breeders or other means such as nuclear fusion or spallation for increasing the neutron supply would significantly lower the use of uranium and thorium but would not necessarily reduce the cost of power. (auth)

16382 APPARATUS FOR FORMING AND CONTAINING PLASMA. Ohkawa, T. (to United States Atomic Energy Commission). U. S. Patent 3,692,626. 19 Sep 1972. Filed 21 Mar 1969.

A plasma method and apparatus are provided with a toroidal plasma confinement region in which a toroidal magnetic field is produced by external magnetic field producing means. A toroidal electrical field is induced within the region by conductors disposed outside of the plasma region so as to produce and maintain a plasma current. The electrical field is produced without producing any substantial additional magnetic field in the region. A second magnetic field in the region is produced by means disposed outside the region so as to provide a plurality of nests of closed toroidal flux surfaces in the toroidal plasma region, thus approximating a field produced by conductors within the region without the associated losses. (Official Gazette)

Wave Phenomena

Refer also to abstract 15722.

16383 NONLINEAR MODE COMPETITION IN BEAM-PLASMA INSTABILITY. Carr, W.; Bollinger, D.; Boyd, D.; Liu, H.; Seidl, M. (Stevens Inst. of Tech., Hoboken, NJ). Phys. Rev. Lett.; 30: No. 3, 84-6(15 Jan 1973).

In a cold beam-plasma system unstable for $f > f_{ce}$, two waves are launched, one at f_0, with large growth rate, and a small test wave at f_T, with small growth rate. The wave at f_0 saturates because of beam trapping, independent of the test-wave amplitude. After the beam is trapped, the test wave ceases growing and exhibits amplitude oscillations in phase with large wave. This is consistent with a linear interaction of the test wave with the modified electron beam. (auth)

16384 INDUCED SCATTERING OF A MONOCHROMATIC PLASMA WAVE. Izmailov, A. N.; Shevchenko, V. I. (Physical-Technical Inst., Kharkov). Nucl. Fusion; 12: No. 6, 637-642 (Dec 1972).

A theoretical and experimental investigation was carried out on the instability of a monochromatic plasma wave due to induced scattering on thermal particles. The authors find theoretical expressions for the growth increment of a test wave through scattering in plasma electrons and ions both without a magnetic field and with a strong magnetic field. The results of the experimental investigation of induced scattering of a monochromatic wave in a strong magnetic field are in satisfactory agreement with the theory evolved. (auth)

16385 NUMERICAL STUDIES OF MAGNETOSONIC COLLISIONLESS SHOCK WAVES. Biskamp, D.; Welter, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 12: No. 6, 663-666(Dec 1972).

Supercritical collisionless shock waves propagating perpendicularly to a magnetic field are studied by means of numerical simulation computations. When ion gyration is neglected, the ion temperature increase through the shock is only due to adiabatic compression. Anomalous ion heating is caused by dissipation of the reflected ions which occurs if ion gyration is included. (auth)

16386 EXPERIMENTAL STUDY OF THE INVERSE FARADAY EFFECT IN PLASMAS. Deschamps, J.; Fitaire, M.; Lagoutte, M. (Paris Univ., Orsay, France). Rev. Phys. Appl.; 7: No. 3, 155-162(Sep 1972). (In French).

When subjected to the electric field of a circularly polarized wave, plasma electrons acquire a magnetic moment and thus create an overall magnetization. An experiment carried out to demonstrate this effect (which is the reciprocal of the classical Faraday effect) established that the magnetic induction produced in this way is proportional to the square of the applied electric field. Pulsed hf signals of several megawatts at 3000 MHz were applied to the plasma, and the variations in the magnetic flux were determined with a coil wound around the plasma. (France)

16387 DEVELOPMENT OF UNSTABLE CYCLOTRON OSCILLATIONS IN INHOMOGENEOUS MAGNETIC FIELD. Timofeev, A. V. (Inst. of Atomic Energy, Moscow). Plasma Phys.; 14: No. 11, 999-1016(Nov 1972).

The development of short-wavelength quasi-classical oscillations in inhomogeneous media is investigated using the Laplace transformation. An equation is found that relates the frequency of the elementary perturbation as a function of space and time. It is shown that the concept of a wave packet has only a limited value in an inhomogeneous media. The investigation is carried out for unstable cyclotron oscillations in inhomogeneous magnetic fields. The development of perturbations in a monotonically varying magnetic field is investigated in detail. The amplification coefficient is shown to be independent of the type of perturbation, and an approximate expression is found for the amplification coefficient for a nonmonotonically varying magnetic field. (auth)

16388 AMPLITUDE MODULATION OF ELECTROMAGNETIC WAVES BY ACOUSTIC WAVES IN A DISPERSIVE PLASMA: MODIFIED THEORY. Virmani, C. J. K. (Bareilly Coll., India). Plasma Phys.; 14: No. 11, 1047-1059(Nov 1972).

An analysis of the modulation of propagating electromagnetic waves in a plasma is presented, in which second-order terms in the current-density expression are considered. It is shown that the inclusion of these second-order terms alters the modulation significantly. Numerical calculations are presented that allow a study to be made of the effect of various parameters on the modulation. (UK)

16389 PARAMETRIC EXCITATION OF CIRCULARLY POLARIZED AND LANGMUIR WAVES IN A MAGNETIZED PLASMA. Lee, K. F. (National Oceanic and Atmospheric Administration, Boulder, CO). Phys. Lett., A; 42A: No. 5, 365-366(1 Jan 1973).

Threshold intensity and growth rate are obtained for the parametric decay instability in which a right-hand circularly polarized pump wave excites a left-hand circularly polarized wave and a Langmuir wave in a magnetized plasma. (auth)

16390 NONLINEAR GENERATION OF IONIZATION WAVES. Perkin, R. M.; Wooding, E. R. (London Univ.). Phys. Lett., A; 42A: No. 5, 367-368(1 Jan 1973).

By including nonlinear terms in the equation for ionization waves it is shown that waves at harmonic and "sum" and "difference" frequencies may be generated. (auth)

16391 NONLINEAR INTERACTION OF LANGMUIR WAVES IN A WEAKLY NONHOMOGENEOUS PLASMA. Lundin, B. V. Zh. Prikl. Mekh. Tekh. Fiz.; No. 6, 6-13(1972). (In Russian).

Kinetic equations were obtained for scattering of a wave of a one-dimensional spectrum by plasma particles for a weakly nonhomogeneous plasma. The equation of evolution of short waves, blocked in the inhomogeneities of plasma density, differed significantly from the kinetic equation for a wave in a homogeneous plasma. The problem of localization of the spectrum of a Langmuir wave is considered in the region of near-minimum plasma density. A solution is obtained for the kinetic equation for a wave that described this process. (tr-auth)

16392 EXCITATION OF RESONANCES BY A DIPOLE ANTENNA INSIDE A HOLLOW CYLINDRICAL PLASMA. Yip, G. L. (McGill Univ., Montreal). Can. J. Phys.; 50: No. 21, 2628-2637(1 Nov 1972).

The problem of the excitation of resonances by a dipole antenna inside a hollow cylindrical plasma is examined. The plasma is assumed to be cold, uniform, isotropic, and lossy. A transversely oriented point electric dipole antenna lying on the axis of the cylindrical plasma is the source under consideration. For a thin and lossless plasma, resonances are found to occur at the two frequencies corresponding to dipolar resonances in a hollow cylindrical plasma as derived earlier by, for example, Kaiser and Closs, and Vandenplas. In addition, there is also an antiresonance at the plasma frequency. The radiation resistance and radiation patterns of the plasma-covered dipole are presented to show the effects of the radii of the plasma tube, the signal frequency and the collision frequency. The possible practical implications of the present study as pertaining to the improvements of reentry communication and the excitation of plasma resonances in ionospheric irregularities are discussed. (auth)

16393 TRANSIENT RADIATION IN HOMOGENEOUS ANISOTROPIC COLD PLASMAS. Chen, K. C. (New York Univ., NY); Yen, J. L. Radio Sci.; 8: No. 1, 51-61(Jan 1973).

A convenient $\omega-\theta$ plot for the group index of refraction is introduced for studying the radiated field from transient current sources of arbitrary orientations in anisotropic cold plasmas. The plot is valid not only for the far zone, but also for the near zone with large time. Typical numerical examples are given to provide the quantitative insight of the transient response in anisotropic cold plasmas. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

Refer also to abstracts 14516 and 14743.

16394 ENERGY SPECTRA TRANSMITTED THROUGH IRON SLABS OF BREMSSTRAHLUNG PRODUCED IN IRON AND GOLD TARGETS BY 0.5 TO 1.44-MeV ELECTRONS. Nakamura, T.; Takemura, M.; Hirayama, H.; Hyodo, T. (Kyoto Univ.). J. Appl. Phys.; 43: No. 12, 5189-96(Dec 1972).

The bremsstrahlung spectra transmitted through iron slabs were measured as a function of incident electron energy and iron-slab thickness. In this experiment, the gold and the iron targets were bombarded by 0.5- to 1.44-MeV electron beams from the Van de Graaff accelerator. Bremsstrahlung produced in the target and transmitted through the iron slab, which emerged at the forward direction of the incident electron beam, was detected with a NaI(Tl) scintillator. The experimental results were in good agreement with those of the approximate numerical calculation of the forward photon spectra. From the slopes of attenuation curves of total photon number and intensity, the effective attenuation coefficients and the effective energies were obtained as a function of the incident electron energy. (auth)

16395 CALCULATION OF THE CONCENTRATION OF β-ACTIVE GASES FROM RADIOMETRIC MEASUREMENTS USING A CYLINDRICAL COUNTER. Gusev, A. A. At. Energ. (USSR); 32: No. 4, 340-2(Apr 1972). (In Russian).

Formulas were developed for calculating concentration coefficient for a radioactive gas, this coefficient being dependent on the geometry, decay scheme of the emitter, and the maximum energy of its β-spectrum. Experimental confirmation of the values calculated from these formulas was obtained by two methods: ^{85}Kr of a known activity was released into a sample or air to be counted, and in a second case measurements were performed directly upon ^{85}Kr. (KSW)

16396 NORMALIZATION OF NEUTRON RADIATION. Zolotukhin, V. G.; Keirim-Markus, I. B.; Kochetov, O. A.; Tsvetkov, V. I.; Cherkashina, O. E. At. Energ. (USSR); 32: No. 4, 338-9 (Apr 1972). (In Russian).

The body of a man is nearly always subjected to neutrons of a wide spectrum of energies, and not of monoenergetic neutrons. In the former case, the dose is maximum at the surface of the body and decreases with depth, whereas for monoenergetic neutrons the maximum may be located at a given depth, and at different depths for neutrons of different energies. The specific equivalent dose of monoenergetic neutrons on the surface of a man's body is shown to be unequal, even for isotropic distribution of the neutrons in space. (KSW)

16397 EFFECTIVE WAVE LENGTH OF X-RAY BREMSSTRAHLUNG SPECTRUM. Zhmudskii, A. Z.; Erniyazov, A. S.; Pakchanin, L. M.; Chestnykh, L. F.; Shiyanovskii, V. I. (Kiev State Univ.). Ukr. Fiz. Zh. (Russ. Ed.); 16: No. 8, 1389-92(Aug 1971). (In Russian).

Special features of x-ray satellite lines may be studied by contrasting the relative spectral intensities of the first and second emission lines. A novel procedure is described for insertion of the effective wavelength of the bremsstrahlung spectrum, for which the quantum yield is fixed for the spectrum. For increasing voltage, the effective wavelength should shift toward the short wavelength for two reasons: the interval of the wavelength of the excited source of bremsstrahlung increases, and the specific weight of the short wavelength component also increases. (KSW)

16398 SHELL-WISE PHOTOELECTRIC CROSS-SECTIONS OF GAMMA-RAYS. Rao, K. S.; Rao, B. V. T.; Rao, B. M.; Parthasaradhi, K. (Andhra Univ., Waltair, India). Nuovo Cim.; 13A: No. 1, 267-70(1 Jan 1973).

Shell-wise photoelectric cross sections of gamma rays at 60, 145,and 320 keV are determined for the elements U, Pb, Au, and Ag. It was found that these values are in general agreement with the theoretical values of Schmickley and Pratt (1967). (auth)

16399 THEORETICAL CONSIDERATION OF THE SOFT X-RAYS ABSORPTION BY THE METALLIC FILMS OF LANTHANUM AND CERIUM. Glembotskii, I. I.; Karosene, A. V.; Kiselev, A. A.; (and others). (Inst. of Physics and Mathematics, Vilnyus, USSR). Liet. Fiz. Rinkinys; 12: No. 2, 235-244(1972).

The absorption spectra of the soft x rays by thin metallic films of lanthanum and cerium are considered theoretically. By making use of the solutions of the conventional Hartree–Fock equations, the energy spectra of $4d^{10}4f^n$ and $4d^94f^{n+1}$ were calculated. Using the wave functions as linear combinations of LS coupling basis functions, the total line strength was calculated, and it was found that the broad maxima can be explained by the electric dipole transitions between the configurations indicated. (auth)

16400 DEPENDENCE OF ENERGY STRAGGLING ON THE ATOMIC NUMBER OF THE ABSORBER. Al-Bedri, M. B.; Harris, S. J.; Sykes, D. A. (Univ. of Surrey, Eng.). Nucl. Instrum. Methods; 106: No. 2, 241-243(1973).

Measurements have been made of the energy straggling of ^{241}Am alpha particles through various gaseous absorbers and the dependence of straggling on the effective atomic number of the gas investigated. (auth)

16401 X-RAY ABSORPTION IN BONE AND MUSCLE. Veigele, W. J.; Henry, E. M. (Kaman Nuclear, Colorado Springs, CO). pp 249-55 of Applications of low energy x- and gamma rays. /Ziegler, C. A. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1971).

From third symposium on applications of low energy x- and gamma rays; Boston, MA (10 Jun 1970). See CONF-700611.

Laboratory and clinical uses of x rays require accurate coefficients describing the probability of occurrence of energy-depositing interactions between x rays and matter. These mass energy absorption coefficients are usually expressed in cm^2/gm. Coefficients for bone and muscle are compiled. Attempts were made to eliminate empirical and previously compiled values. (ERB)

Radiation Protection Standards

Refer also to abstract 14957.

Radiation Source Calibration and Standardization

Refer also to abstract 14677.

16402 DOSE RATE DISTRIBUTION OF CAGE-TYPE GAMMA RADIATION SOURCE. Yamamoto, Hisao (Kyushu Univ., Fukuoka); Sonoda, Masateru; Shimozawa, Ryosuke; Shibuya, Yoko. Kyushu Daigaku Kogaku Shuho; 45: No. 3, 317-323(Jun 1972). (In Japanese).

It was required that dose rate distributions around a gamma source should be re-checked because a part of the source arrangement had been recently changed in the equipment installed at the ^{60}Co irradiation facility of Kyushu University. A Fricke dosimeter was used in which Fe^{2+} ions are oxidized to Fe^{3+} when an 0.8 N ferrous sulfate aqueous solution saturated with air or oxygen is irradiated. In order to determine the generated Fe^{3+}, the increment of optical density was measured at the wavelength of 3040 Å to indicate maximum absorption with a double-beam spectrophotometer. A method to correct error in the dose rate measurement which is based on the time required to raise or lower the source when the measurement is conducted at a high dose rate position near the source is described. (Japan)

Shielding Calculations and Experiments

Refer also to abstracts 15335, 15359, 16026, and 16374.

PHYSICS (SOLID-STATE)

Radiation Effects

Refer also to abstracts 14802 and 14927.

16403 (IAE–2103) STUDY OF ISOCHRONOUS ANNEALING OF POINT DEFECTS FOR UNFILLABLE SINKS. Al'tovskii, I. V. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 15p. INIS.

A quantitative description was sought for the isochronous annealing of defects in irradiated material at specific points. A new method is proposed for the determination of the activation energy of defect migration to holes, and of the frequency factor as derived from the curve of isochronous annealing. No other information is required for this method other than that contained in the specified curve. The shape of the curve of isochronous annealing was investigated for Frenkel pairs and their mutual annihilation. (tr-auth)

16404 REACTOR-IRRADIATED POLYCRYSTALLINE α-Al_2O_3: AN E.P.R. STUDY. Galli, A. (CNEN, Rome). Lett. Nuovo Cim.; 5: No. 6, 473-7(7 Oct 1972).

Studies were made on the effects of in-pile γ-only and mixed (γ plus neutron) irradiation on Lucalox (polycrystalline α-Al_2O_3, 99.9% pure). Analysis of the irradiated specimens was performed at room temperature with a Bruker B-ER 418 S EPR spectrometer, operated at about 9.40 GHz. The results for mixed irradiation of α-Al_2O_3 showed that: defects such as those assumed in γ-irradiated crystals were produced; at the temperature of the reactor (75°C) these were the main centers that contribute to the strong absorption at $g \approx 2.0$; and this absorption in Lucalox can be fairly well correlated with the absorption in γ-irradiated crystals. All this supports the more general validity of the models proposed in γ-irradiated crystals and explains unequivocally the nature of the strong absorption at $g \approx 2.0$ in mixed irradiation of crystals. Also, for mixed irradiation, a saturation effect was displayed rather clearly by the central absorption. (PCH)

16405 RADIATION EFFECTS IN n-TYPE SILICON IRRADIATED WITH 10-MeV PROTONS. Vavilov, V. S.; Isaev, N. U.; Mukashev, B. N.; Spitsyn, A. V. (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 6, 907-911(Dec 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 6, 1041-1045 (Jun 1972).

An investigation was made of the formation of defects in n-type silicon irradiated with protons at 78 and 273°K. The rate of introduction of defects depended strongly on the irradiation temperature and, in contrast to electron irradiation, it was higher at 78°K than at 273°K. An analysis of the influence of isochronous annealing (78 to 700 and 280 to 700°K) indicated that when n-type silicon was irradiated with protons decelerated mainly because of ionization losses, the principal defects were point defect–impurity complexes and divacancies. (auth)

16406 PARAMAGNETIC CENTERS GENERATED BY ION BOMBARDMENT OF SILICON. Gerasimenko, N. N.; Dvurechenskii, A. V.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 6, 965-968(Dec 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 6, 1111-1114 (Jun 1972).

Irradiation of silicon with Ne^+, Ar^+, Xe^+, P^+, and O^+ ions of energies 10 to 150 keV produced paramagnetic centers with $g = 2.0055$ (VV centers). The profile and width of the ESR line of these centers was studied as a function of the radiation dose. An investigation was made of the nature of broadening of this line and of the influence of the ion energy and dose on the distribution of the VV centers with depth. It is suggested that at low radiation doses the VV centers combine to form clusters. An attempt is made to provide an analytic description of defect accumulation. A model of the conversion of silicon to the amorphous state is considered on the basis of the relationships governing the formation of defects by ions. (auth)

16407 SYNTHESIS OF SILICON CARBIDE BY IMPLANTATION OF Si IONS IN DIAMOND. Akimchenko, I. P.; Vavilov, V. S.; Galkin, V. V.; (and others) (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 6, 1039-1041(Dec 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 6, 1182-1184 (Jun 1972).

35-keV ^{28}Si ions were ion implanted in diamond wafers 300 to 500 μ thick at room temperature. The total dose was 4.1×10^{17} cm^{-2}. The synthesized SiC was identified from optical absorption and electroreflection spectra at 0.225 to 25 μ. Results indicate that the implantation of Si ions in diamond produced α-SiC with a strongly disordered crystal structure, which changes to the β-SiC modification upon heat treatment. (DLC)

16408 SOME ASPECTS OF ION DOPING OF CdTe. Agrinskaya, N. V.; Arkad'eva, E. N.; Guseva, M. I.; (and others) (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 3, 407-409(Sep 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 3, 473-476(Mar 1972).

Implantation of P^+ and As^+ ions into "cold" and "hot" n-type CdTe substrates produced inversion of conduction and n–p structures. The acceptor action of the impurities introduced in this way was supported by experiments in which Ar^+ ions were implanted and the photoluminescence spectra were measured. Doping of p-type CdTe by the implantation of B^+, In^+, Cd^+, and F^+ ions did not result in inversion. The impurity photoluminescence spectra indicated that unannealed samples contained donor (D) and acceptor (cadmium vacancies V_{Cd}) centers which formed $[D-V_{Cd}]^-$ complexes. The acceptor action of these complexes evidently prevented the formation of an inversion layer in p-type CdTe. It was found that a continuous amorphous layer did not appear near the surface of CdTe crystals even when the radiation dose was as high as $\sim 6 \times 10^{16}$ cm^{-2}. (auth)

16409 ASYMMETRY OF THE DAMAGE REGIONS GENERATED BY HIGH-ENERGY PARTICLES IN SEMICONDUCTORS. Litvinov, V. L.; Sadikov, V. P.; Smilga, V. P.; Ukhin, N. A. (Inst. of Atomic Energy, Moscow). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 3, 460-461(Sep 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 3, 536-538(Mar 1972).

In order to determine whether damage regions are elongated along the incident beam, the electrical properties of Si, Ge, and GaAs were studied after irradiation by a directional 26-MeV electron beam below 40°C. Results indicated that the change in resistivity depends on the orientation of the incident beam relative to the electric field. Control experiments determined that the observed anisotropy is due to the beam direction and not to nonuniform impurity distributions. The irradiation reduced the Hall mobility, and an asymmetry was also observed. (DLC)

16410 KINETICS OF THE FORMATION AND ANNEALING OF RADIATION DEFECTS IN CRYSTALS. Vasil'ev, A. V. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 4, 522-527(Oct 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 4, 603-608(Apr 1972).

The concept of a barrier for the formation of complexes consisting of vacancies and chemical impurities in crystals is used to analyze the time (dose) and temperature dependences of the concentrations of two types of complex created as a result of irradiation and annealing. The obtained equations describe the annealing- and irradiation-induced transfer of vacancies and interstitial atoms from one type of complex to another. They also describe the saturation of the concentration of complexes (as a function of the irradiation dose) in the absence of saturation of impurities introduced into a crystal, the dependences of the concentrations of complexes on the irradiation temperature, and other effects. It is found that the concept of a barrier provides a basis for a more consistent description of the behavior of irradiated and annealed crystals. (18 references) (auth)

16411 INSULATION OF p–n JUNCTIONS IN PROTON-IRRADIATED GALLIUM ARSENIDE. Mamontov, A. P.; Nichipurenko, B. A.; Okunev, V. D.; Presnov, V. A. Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 4, 617-618(Oct 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 4, 717-720(Apr 1972).

P–n GaAs junctions were produced by Zn diffusion in n-type GaAs, and insulation of these junctions was effected by proton irradiation. The proton irradiation reduced the area of the p–n junction, reduced considerably the reverse current, and increased the breakdown voltage. Results show that insulation by proton irradiation is an effective means of improving the characteristics of the junctions. (DLC)

16412 RADIATION-DEFECT ANNIHILATION CENTERS. Vasil'ev, A. V.; Rybakova, L. A.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 4, 631-632(Oct 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 4, 733-734(Apr 1972).

P-type Ge was irradiated at 600°K with 3.5-MeV electrons, irradiated again at 300°K, and heated to 600°K for 2 h. After each step, the steady-state photoconductivity signal was measured to determine the nonequilibrium carrier lifetime at 300°K. Results can be explained if the recombination centers formed by irradiation at 600°K are destroyed by further irradiation at 300°K, owing to the arrival of particles of the opposite kind. (DLC)

16413 BROADENING OF THE DIFFUSION PROFILES IN SILICON UNDER THE ACTION OF IONIZING RADIATION. Koifman, A. I.; Niyazova, O. R. (Inst. of Nuclear Physics, Ulugbek, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 4, 656-657 (Oct 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 4, 757-758(Apr 1972).

Silicon photodiodes diffused with Zn or Ga were irradiated in a VVR-S reactor channel. The impurity distribution became broader under irradiation, and the degree of broadening was greater for Zn than Ga. The position of the p-n junction was practically unaffected by the irradiation for Ga, but displaced into the crystal by $10 \pm 0.5\ \mu$ for Zn. (DLC)

16414 EFFECT OF PLASTIC DEFORMATION AND RADIATION DAMAGE ON THE ELECTRICAL RESISTIVITY CHANGES IN TANTALUM. Ibrahim, A. A.; Hammad, F. H.; Ammar, A. A. (Atomic Energy Establishment, Cairo). J. Less-Common Metals; 30: 97-104(1973).

The effects of torsional deformation on the electrical resistivity changes, $\Delta\rho/\rho_0$, in tantalum wires were examined for unirradiated and irradiated specimens. $\Delta\rho/\rho_0$ was found to increase with $\bar{\gamma}$ (mean torsional shear strain) in a manner described by $\Delta\rho/\rho_0 = A\ \gamma^m$ where m was found to be 0.81 at $\bar{\gamma} < 140\%$ and 0.25 at $\bar{\gamma} > 140\%$ for measurements at room temperature. At liquid nitrogen temperature m was found to be 1.9 at $\bar{\gamma} < 70\%$ and 0.4 at $\bar{\gamma} > 70\%$. These results indicate that the electrical resistivity changes arise mainly from point defects at early stages of deformation and at low temperatures. At later stages of deformation the contribution arises mainly from dislocations. The changes in $\Delta\rho/\rho_0$ for wires irradiated in a fast integrated neutron dose from 2.25×10^{17} n/cm^2 up to 2.16×10^{18} n/cm^2 were less than in unirradiated specimens. This was attributed to defect annihilation arising from the interaction between defects generated by cold working and radiation-induced defects. (auth)

16415 ELECTRICAL CONDUCTIVITY OF DIAMOND CONTAINING IMPLANTED LITHIUM IONS. Vavilov, V. S.; Gukasyan, M. A.; Guseva, M. I.; Konorova, E. A. (Lebedev Inst. of Physics, Moscow). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 5, 741-746(Nov 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 5, 858-864(May 1972).

An investigation was made of the electrical conductivity of diamond lamellas containing implanted lithium ions, after annealing at temperatures up to 1400°C. The implantation took place in an unoriented target. It is shown that n-type diamonds with a reformed lattice may be obtained by the implantation of lithium ions. The activation energy for electrical conduction is 0.17 eV. After annealing, the conductivity increases by several orders of magnitude. The maximum conductivity occurs at a depth which is nearly three times that at which the maximum is found before annealing. This shows that lithium ions have an anomalously large depth of penetration into the crystal. The continued existence of a conducting layer at this depth is clearly associated with the low concentration of radiation defects in this region of the crystal. (auth)

16416 DISTRIBUTION OF RADIATION DEFECTS IN GALLIUM ARSENIDE IRRADIATED WITH DEUTERONS. Mamontov, A. P.; Okunev, V. D.; Gaman, V. I.; Zakharov, B. G. (Physical-Technical Inst., Tomsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 5, 747-749(Nov 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 5, 865-868(May 1972).

A study was made of the distribution of the luminescence intensity in gallium arsenide irradiated with deuterons. The dependence of the intensity on the energy and on the total deuteron dose was measured by the electron probe method. The energy dependence of the deuteron range is calculated and compared with the experimental values deduced from the spatial variation of the cathodoluminescence. It is found that the coefficient K governing the change in the lifetime due to irradiation of n-type gallium arsenide increases with increasing initial carrier density and varies, in the terminal part of the deuteron path, from 1.35×10^{-2} (sec · deuteron · cm^{-2})$^{-1}$ for a sample with a carrier density $n = 7 \times 10^{15}$ cm^{-3} to 8.4×10^{-2} (sec · deuteron · cm^{-2})$^{-1}$ for a sample with a carrier density $n = 4.5 \times 10^{17}$ cm^{-3}. The distribution of defects along the deuteron path is characterized by a spatial dependence of the coefficient K. Good agreement is obtained between the measured distribution of K and the theoretical values calculated from the rate of generation of defects n_d. (auth)

16417 CONDUCTION IN DISORDERED REGIONS PRODUCED BY BOMBARDMENT OF SEMICONDUCTORS WITH HEAVY PARTICLES. Lezheiko, L. V.; Pridachin, N. B.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 5, 775-777(Nov 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 5, 899-902(May 1972).

A study was made of the changes in the conduction in two-component GaAs bombarded with ions and monatomic diamond bombarded with protons. The results are interpreted by assuming a spatial separation of the simplest defects in a disordered region that arises at the end of the track of an implanted ion. The changes in the conductivity in the two materials were correlated. It is noted that the annealing of such a system must pass through a stage in which there is compensation of the conduction by the simplest defects liberated when large complexes disintegrate. (auth)

16418 MODEL OF DISORDERED REGIONS IN SILICON PRODUCED BY FAST NEUTRONS. Ukhin, N. A. Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 5, 804-806(Nov 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 5, 931-934(May 1972).

In order to estimate the parameters for the rates of the maturing of damaged regions and the spatial distribution of stable defects after fast annealing, a system of transport equations was solved for the following model for the formation of disordered regions: A complex of vacancies and interstitial atoms is created; the migrating interstitial atoms can annihilate with single vacancies or leave the damaged region; and single vacancies can form immobile stable complexes with impurities or divacancies. The model predicts that a disordered region consists of a core saturated with divacancies and a shell of vacancy-impurity complexes. (DLC)

16419 FORMATION OF INTRINSIC RADIATION DEFECTS IN CaF_2, SrF_2, AND BaF_2 UNDER THE INFLUENCE OF A LOW-TEMPERATURE PLASMA FLOW. Zavadovskaya, E. K.; Baranov, A. I.; Lisitsyn, V. M. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 148-50(1972). (In Russian).

Samples of CaF_2, SrF_2, and BaF_2 were subjected to a current of low-temperature plasma at temperatures not exceeding 100°C and for periods of time up to three hours. Absorption spectra of the three fluorides were determined before and after annealing the crystals at temperatures up to 350°C. A diminution in the 680 nm band in BaF_2 at 120°C was particularly striking. (KSW)

16420 KINETICS OF RADIATION-INDUCED CHANGES IN CRYSTAL DENSITY. Ovcharov, A. T.; Kalinin, M. I.; Lisitsyn, V. M. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 139-41(1972). (In Russian).

Samples of CaF_2 were subjected to 4.5-MeV protons at room temperature in order to study the resulting changes in the crystal. The relative decrease in density (except for an initial phase) was linear over a broad range of proton doses (to 2.8×10^{18} p/cm^2). Absorption spectra of the irradiated crystals revealed that, of the four normal absorption bands, the 560 nm band was affected quite differently from the changes for the bands at 225, 335, and 400 nm, and represented evidence of massive internal defects in the crystal. (KSW)

16421 OHMIC CONTACTS ON n^+- AND p^+-Si BY ION IMPLANTATION. Feuerstein, A.; Kalbitzer, S. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Appl. Phys. Lett.; 22: No. 1, 19-20(1 Jan 1973).

Thin layers of n^+- and p^+-Si were metallized by implantation of ion doses of 10^{17} Al/cm^2 at energies of 8 keV. Ohmic characteristics were obtained after moderate annealing treatments. (auth)

16422 AXIAL CHANNELING IN ThO_2. Clinard, F. W. Jr.; Sanders, W. M. (Los Alamos Scientific Lab., NM). J. Appl. Phys.; 43: No. 12, 4937-42(Dec 1972).

Axial channeling in single-crystal ThO_2 was investigated with 6.5-MeV $^3He^{2+}$ ions. The thorium sublattice was studied by evaluation of pulse-height distributions from backscattered ^3He ions, and the oxygen sublattice by evaluation of proton pulse-height distributions from $^{16}O(^3He,p)^{18}F$ reactions. Critical channeling angles ($\psi_{\frac{1}{2}}$) and minimum yields (χ_{min}) were determined for the ⟨110⟩ and ⟨111⟩ directions. Values for $\psi_{\frac{1}{2}}$ were generally consistent with those reported for the isomorphic compound UO_2, whereas χ_{min} values were considerably smaller than those reported for UO_2. These results are compared with those predicted by current channeling theories, and are discussed in terms of the relative crystal perfection of ThO_2 and UO_2. (auth)

16423 MAGNETOPHOTOCONDUCTIVITY OF SEMI-INSULATING GaAs AND ITS BEHAVIOR UPON ELECTRON BOMBARDMENT. Nomicos, C. D.; Euthymiou, P. C. (Univ. of Athens). J. Appl. Phys.; 43: No. 12, 5131-4(Dec 1972).

The effect of a magnetic field on the photoconductivity of semi-insulating p-type GaAs single crystals mounted in the Voigt geometry was investigated within the temperature region 260 to 350°K. If the magnetic field deflects the photocarriers toward the volume of the specimen, a decrease of the photoconductivity is obtained for weak electric field and an increase for high electric field under constant magnetic field. The decrease is attributed to the combination of photoconductivity and photomagnetoelectric effects, while the increase is attributed to the difference in the values of lifetime across the specimen thickness. From photoconductivity measurements with and without the application of magnetic field, the carrier lifetimes were determined. Bombardment of the specimen with 1-MeV average-energy β particles resulted in a decrease of the magnetophotoconductivity at high electric fields. (auth)

16424 POSITIVE-ION BOMBARDMENT OF SUBSTRATES IN rf DIODE GLOW DISCHARGE SPUTTERING. Coburn, J. W.; Kay, E. (IBM Research Lab., San Jose, CA). J. Appl. Phys.; 43: No. 12, 4965-71(Dec 1972).

The plasma potential and the potential of an electrically isolated surface are measured in an rf diode sputtering glow discharge. The influence on these potentials of both the geometry enclosing the discharge volume and of a positively biased auxiliary electrode in contact with the discharge is investigated. It is shown that confining the discharge increases the plasma potential and the energy of positive ions incident on electrically isolated substrates, whereas applying a positive voltage to an auxiliary electrode also increases the plasma potential but does not significantly increase the energy of ions incident on electrically isolated substrates. The effect of rf modulation on the ionic energy distributions is demonstrated. This occurs as the ions pass through the plasma–substrate sheath and results in a large broadening of the energy distributions of low-mass species. (auth)

16425 SUPERLATTICE OF VOIDS IN NEUTRON-IRRADIATED TUNGSTEN. Sikka, V. K.; Moteff, J. (Univ. of Cincinnati). J. Appl. Phys.; 43: No. 12, 4942-4(Dec 1972).

Transmission electron microscopy of tungsten irradiated at about 550°C to a fast neutron fluence of approximately 1×10^{22} neutrons cm^{-2} reveals the formation of a superlattice of voids. The void lattice parameter is 195 Å and the lattice parameter to average void size is about six. Both the formation of the superlattice and the temperature dependence of the lattice parameter in tungsten, a material considered to have isotropic elastic properties, is in contradiction to present theories based on the elastic anisotropy of the host metal. (auth)

16426 PROTON IRRADIATION AT 30°K AND ISOCHRONAL ANNEALING OF REACTIVELY SPUTTERED Ta THIN-FILM RESISTORS. Shewchun, J.; Hardy, W. R.; Pronko, P. P. (McMaster Univ., Hamilton, Ont.). J. Appl. Phys.; 43: No. 12, 4915-21(Dec 1972).

Tantalum thin-film resistors reactively sputtered in oxygen and nitrogen simultaneously were irradiated by 150-keV protons at 30°K. The observed conductance increase of the films is ascribed to radiation-produced defect levels within the inter-island regions of Ta_2O_5 in these discontinuous films. The nonlinearity of the conductance increase with fluence may be accounted for by a nonlinear rate of defect production due to a combination of spontaneous recombination and close-pair thermal annealing. The number of unstable sites surrounding each defect is found to be equal to or greater than four for crystalline Ta_2O_5. Thermal recovery of the damage proceeds in two main stages: Stage A (34 to 150°K) possesses some substructure and is attributed to close-pair or correlated recombination; stage B (150 to 300°K) is very broad and structureless and is attributed to uncorrelated annihilation of defects at the gap–island interface. Negative annealing stages (characterized by a conductance increase) indicate a metallic conduction process via connected metallic islands. (auth)

16427 EXPANSION, CRAZING, AND EXFOLIATION OF LITHIUM NIOBATE ON ION BOMBARDMENT AND COMPARISON RESULTS FOR SAPPHIRE. Primak, W. (Argonne National Lab., IL). J. Appl. Phys.; 43: No. 12, 4927-33(Dec 1972).

Surface deformation and destruction resulting from bombardment with respective 140-keV ions H^+, D^+, He^+, and Ne^+ were observed. Following bombardment, spontaneous secular changes occurred over a period of many months at room temperature. Optical absorption curves of the specimens showed interference effects. Calculations of optical interference patterns caused by blistering are given. Some bombarded lithium niobate surfaces became crazed. The patterns consisted of fractures parallel to the ZY plane, despite no evidence of cleavage. Exfoliation occurred by material from the areas between the fractures breaking away. The surface deformation of a proton-bombarded specimen annealed below 300°C simultaneously with the intense optical absorption caused by the hydrogen. Calculations of effects to be expected from neutron irradiation are given. The depths of the effects are compared with the particle ranges and appear to be close to their median projected ranges. The depths are greatly in excess of the ranges calculated from Lindhard's theories, which overestimate the electronic stopping power at these energies. The radiation effects along the range are important in determining the blistering behavior. The piezoelectric effect may be the cause of the crazing parallel to Y. (auth)

16428 DEVELOPMENT OF RELIEF STRUCTURES ON Si SURFACES BY ION BOMBARDMENT. Punzel, J.; Hauffe, W. (Technical Univ., Dresden). Phys. Status Solid (a); 14: No. 2, K97-99(16 Dec 1972).

The effects of foreign atoms on the development of relief structure in the 10-keV Ar^+ ion bombardment of Si(111) surfaces were studied by means of a modification of Wehner's experiment (J. Appl. Phys., 42: 1145 (1971)), using a metal cylinder to produce a shadow. Two domain areas were observed in the bombarded area: one shows a strong relief formation, while the other is sputtered without any structure development. The relief structure is associated with the striking of atoms from the cylinder. This was observed for steel, Mo, and Cu cylinders, but not for Al or Si cylinders. (DLC)

16429 ION PAIRING IN p-InSb INDUCED BY X-RAYS. Mashovets, T. V.; Vikhilii, G. A.; Vitovskii, N. A. (Ioffe Inst. of Physics and Tech., Leningrad). Phys. Status Solid (a); 14: No. 2, 439-442(16 Dec 1972).

A decrease in the donor and acceptor concentrations was observed in p-InSb under x-irradiation at low temperatures. Radiation-induced migration of Ge atoms and donor–acceptor ion pairing have been suggested. (auth)

16430 VOID FORMATION EXPERIMENTS. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). Atom (London); No. 194, 213-217(Dec 1972).

The mechanism of the formation of voids, vacancies, dislocations, and interstitials in reactor fuel materials is first briefly discussed. The elastic scattering cross section for charged-particle collisions is, in general, several orders of magnitude higher than for neutron–atom collisions, and for this reason damage buildup that takes years in a reactor can, in principle, be simulated within hours in a particle accelerator. A limitation, however, is that whereas fast neutrons produce uniform radiation damage throughout a large specimen, ion bombardment can only result in damage to a depth roughly equal to the ion range in a material, and this is relatively small. Use of the Harwell Variable Energy Cyclotron for void formation investigations is described, including employment of a rocking target holder. Until recently the bombarding species has been 20-MeV C^{2+} ions, but 48-MeV Ni^{5+} ions are now being used. In order to relate the results of VEC irradiations to reactor irradiations the damage density for a particular fast neutron spectrum must be known, and calculations have been made for spectra in the Dounreay Fast Reactor. Voids are shown for two Ni specimens, one irradiated in the DFR and the other in the VEC with C ions; the similarity is readily apparent. The temperature dependence of void swelling in stainless steels is shown graphically, as well as void swelling as a function of dose in Ni, stainless steels, and Nimonic irradiated with 20-MeV C ions. It is emphasized that it is necessary to produce the damage sufficiently far away from surfaces for the dislocation and point-defect concentrations to be unaltered by the proximity of the surfaces. (UK)

16431 SPECTROSCOPIC PROPERTIES OF RUBY AND NEODYMIUM LASERS UNDER THE ACTION OF ^{60}Co GAMMA RAYS. Bedilov, M. R.; Khaidarov, K.; Khaitbaev, K. (Inst. of Electronics, Tashkent). Dokl. Akad. Nauk. Uzb. SSR; No. 8, 30-33(1972). (In Russian).

The change in optical properties of the active components of ruby and Nd lasers as a result of the action of ^{60}Co γ rays was investigated in the region 2200 to 11,000 Å. The laser elements were given doses from 0 to 10^8 R at 36°C. The four intense bands at 4300, 4700, 5200, and 5800 Å of the Nd laser were not shifted by the irradiation, but the intensities of 4300 and 4700 were increased by a factor of five by a 10^8-R dose. A new band developed at 6650 Å, beginning with a dose of 10^4 R. Irradiation of the ruby laser caused the absorption spectra to increase in all three of its bands (2550, 4000, and 5500 Å). (KSW)

16432 RADIATION CENTERS IN QUARTZ GLASS IRRADIATED BY NEUTRONS. Vakhidov, Sh. A.; Sanaev, B.; Usmanova, S. Kh. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk. Uzb. SSR; No. 8, 34-36(1972). (In Russian).

The formation of radiation centers in quartz glass under the influence of neutrons and γ radiation, respectively, was studied by EPR and optical spectroscopy. (Two temperatures were used: 340 and 77°K.) In the EPR spectrum of neutron-irradiated glass, a new signal ($g = 2.008$) ($\Delta H = 10$ Oe) was added to the set characterizing the original glass. This new signal was duplicated by the γ irradiation of the glass only at 77°K. The signal at $g = 2.008$ was interpreted as loss of a H atom from an OH group. (KSW)

16433 ELECTRON BEAM IRRADIATION OF Nd^{3+}-ACTIVATED GLASS. Arifov, U. A.; Bedilov, M. R.; Khaidarov, K. (Inst. of Nuclear Physics, Tashkent). Dokl. Akad. Nauk Uzb. SSR; No. 11, 20-2(1971). (In Russian).

The quantum yield of Nd^{3+}-activated glass was investigated as a function of the energy of the electron beam used to irradiate the glass (from 30 to 120 keV), and as a function of the intensity of the beam from 0 to 240 μA. A maximum response of the glass was obtained with a beam current of 125 μA; response fell off rapidly at higher or lower beam currents. (KSW)

16434 TEMPERATURE DEPENDENCES OF PHOTO-STIMULATED ELECTRON EMISSION. Bichevin, V. V. Tr. Inst. Fiz. Astron., Akad. Nauk. Est. SSR; No. 39, 188-201(1972). (In Russian).

Temperature dependences of photostimulated electron emission of NaCl, KCl, KBr, and KI single crystals were examined. The crystals were first excited with x rays or ultraviolet radiation, and the emitted electrons were counted with an electron multiplier in a vacuum of 10^{-7} to 10^{-5} torr. The observed enhancement of the emission yield in the region from 230 to 320°K may be associated with some chemisorption phenomena on crystal surfaces. To account for the results one has to suppose that, while the crystals are photostimulated with light from the F-band region, photoelectrons can leave the crystal only through some kind of "contaminated" regions on the surface. (auth)

16435 ELEMENTARY MECHANISMS OF CREATION OF RADIATION DEFECTS IN IONIC CRYSTALS. Lushchik, Ch. B. Tr. Inst. Fiz. Astron., Akad. Nauk Est. SSR; No. 39, 81-99(1972). (In Russian).

The exciton, electron-hole and ionization mechanisms of radiation-induced coloration of ionic crystals are discussed. In alkali metal halides, the energy of exciton (E_e) is higher than the energy of the creation of a pair of Frenkel defects (E_d). Due to the inequality $E_e > E_d$, the alkali metal halides are likely to undergo radiation damage. The spectrum of the formation of color centers by ultraviolet radiation in alkali metal halides covers the region of exciton absorption. The self-trapped excitons may break up and produce radiation damage in perfect lattice regions. The decay of excitons may produce F centers and H centers. The electron-hole recombination may produce I centers and α centers. Perhaps the decay of exciton may produce a cation vacancy and interstitial cation. 83 references. (auth)

16436 RADIATIVE COLORATION AND RECOMBINATION LUMINESCENCE OF NaCl WHISKERS. Elango, A. A. Tr. Inst. Fiz. Astron., Akad. Nauk Est. SSR; No. 39, 100-111(1972). (In Russian).

The study of radiative coloration of NaCl whiskers, irradiated with x rays and ultraviolet light, is carried out by means of the absorption method and thermostimulated luminescence method. In thermal glow curves of NaCl whiskers, three maxima are observed ($T_m = 350$, 470, and 570°K). Most intensive is the peak with $T_m = 570$°K, which does not appear in the thermal glow curves of NaCl crystals grown from the melt. The intensity of the peak with $T_m = 470$°K grows with an increase of vacancy concentration (preliminary x irradiation and following optical bleaching). Thermal glow curves of NaCl whiskers, irradiated with ultraviolet light, selectively creating excitons and electron–hole pairs, are analogous to thermal glow curves of x-irradiated NaCl whiskers. It is supposed that recombinations of spatially slightly divided hole and F color centers correspond to the thermal glow peak with T = 470°K, whereas strongly divided hole and F color centers correspond to peak with $T_m = 570$°K. Color centers are supposed to appear in NaCl whiskers as a result of exciton decay together with arising Frenkel defects. Higher intensity and stability of the coloration of NaCl whiskers can be explained by an easier (due to the small size of whiskers) emerging of a part of reaction products upon the surface. (26 references) (auth)

16437 APPARATUS FOR MEASUREMENTS OF LUMINESCENT PROPERTIES OF SOLIDS IRRADIATED BY ULTRASOFT X RAYS. Saar, A. M. E.; Grishakov, F. P.; Elango, M. A. Tr. Inst. Fiz. Astron., Akad. Nauk Est. SSR; No. 40, 111-118(1972). (In Russian).

A highly sensitive apparatus for measurements of luminescent properties of solids irradiated by ultrasoft x rays with photon energy of 100 to 2000 eV is described. The x-ray spectrometer–monochromator RSM-500 is used as the source of monochromatic radiation. The object of irradiation is placed on one focus of the elliptic mirror. The cooled cathode of the registering photomultiplier is placed on another focus of the mirror. The photomultiplier acts as a photon counter. Some examples of measurements of stationary as well as thermo- and photostimulated luminescence of KI and KCl crystals, irradiated by photons with energy of 100 to 300 eV, are presented. (auth)

16438 ANNEALING CHARACTERISTICS OF BORON-IMPLANTED LAYERS IN SILICON. Maekawa, Hiroshi; Kobayashi, Toshihiko; Matsumori, Tokue (Tokai Univ., Tokyo). Tokai Daigaku Kiyo Kogakubu; 1972: No. 1, 9-15(Sep 1972). (In Japanese).

Studies on ion implantation of boron in silicon have been widely performed. It is also well known that reverse annealing arises in the process of annealing. In this report, boron was implanted into cold (77°K), room temperature (25°C), and hot (400°C) silicon substrates, respectively. Reverse annealing characteristics were observed in cases of the samples implanted at hot and room temperature, but not in cold-implanted samples. These phenomena are explained by considering the reverse-annealing characteristics to be due to the change in the carrier distribution and boron atoms replaced from the substitutional site to the interstitial site. (auth)

16439 APPARATUS FOR THE SELECTIVE SPUTTERING OF SOLID SUBSTANCES BY MEANS OF ION BOMBARDMENT ACCORDING TO THE PLASMA OR TO THE ION-BEAM PROCESS. Fiedler, O. (to VEB Elektromat). British Patent 1,294,697. 1 Nov 1972. Filed date 11 Nov 1969. 7p.

Some disadvantages of existing apparatuses are described, including that such apparatuses normally are intended for use either in an ion-plasma sputtering process or an ion-beam sputtering process. The apparatus described may be used in both processes. The discharge system is located in an evacuated chamber containing the target to be sputtered and the substrate to be coated, and comprises a single ionization chamber and an electrode assembly, surrounded by a cooled double-walled cylinder made of nonferromagnetic material. This is connected to an extractor system consisting of a separate adjustable unit comprising a counter cathode, an insulating cylinder, an extractor electrode, and a protection electrode. The electrode assembly is of the Penning type. Details are given of the cooling system, the counter cathode, the extractor electrode, and the protection electrode. In order to provide an axial magnetic field a coil is provided in the discharge member, having an iron jacket between the metal wall in contact with the cooling medium. (UK)

16440 LIFETIME MEASUREMENTS OF CHARGE CARRIERS IN GERMANIUM AFTER 14 MeV-NEUTRON IRRADIATION AT 77 K. Metasch, H. D. Kiel; Univ. Kiel (1971). 74p. (In German).

Thesis.

The resistance and lifetime of the surcharge carriers were measured on antimony-doped germanium with resistivities between 8 and 25 ohm-cm within the range of 77 to 300°K as a function of the temperature. The lifetime was measured by observing the reduction of the photoconductivity following a gamma-ray pulse. A comparison with theoretical concepts of the recombination mechanism will provide values for the determination of the cross sections for the capture of electrons and holes in the recombination centers and of the position of the energy levels of these centers in the forbidden band. Further investigations were concerned with the isochronous recovery in the range between 77 and 300°K after irradiation with 14 MeV neutrons at liquid-oxygen temperature. Such temperature measurements yield information on recovery stages at which defects are shifted or annealed. The annealing temperatures character-

istic of certain defects offer the possibility of gaining a better insight into the recovery process. (GF)

Physical Properties

Refer also to abstracts 14764, 15168, 15171, 15219, 15249, 15274, 15275, 15315, 15734, 16095, and 16167.

16441 (NP-19641) TABLES OF MAGNETIC STRUCTURES DETERMINED BY NEUTRON DIFFRACTION. SUPPLEMENT II. Oles, A.; Kajzar, F.; Kucab, M. (Institute of Nuclear Techniques, Krakow (Poland)). Jul 1972. 73p. (INT-24). Dep. NTIS (U. S. Sales Only).

The tables were elaborated on the basis of the original papers. The tables contain the chemical symbol of the substance, its space group, crystallographic data, cation distribution, temperatures of magnetic transitions, a brief description of magnetic structure including some figures, magnetic moments and their directions, effective magnetic moments, and references on magnetic additional properties. Magnetic space groups for stoichiometric compounds are given. The supplement II contains compounds and alloys omitted in previous parts of the tables. (27 figures, 273 references) (auth)

16442 MAGNETIC ANISOTROPY OF A SEMIHARD MAGNETIC ALLOY OF Co–Fe–Nb SYSTEM. Kassai, Makoto; Okada, Masanori; Sasaki, Tatsuji; Henmi, Zenzo (Fujitsu Labs., Ltd., Kawasaki, Japan). J. Jap. Inst. Metals; 36: No. 11, 1156-7(Nov 1972). (In Japanese).

Torque coefficients are presented for cold-rolled Co–12Fe–3Nb for the following annealing temperatures: as-rolled, 500, 600, 700, 750, 800, 900, and 1000°C. Also, plots of torque (a.u.) vs angle from rolling direction (0 to 90°) are presented for cold-rolled and 600-, 800-, and 900°C-annealed specimens, with separation of the torque curves into two parts, crystal anisotropy terms, L_c, and uniaxial anisotropy terms, L_i. Finally, a plot is shown of the variation in the apparent crystal and uniaxial anisotropy constants with annealing temperature. (LMT)

16443 ANALYSIS OF TRIPLE DISLOCATIONS IN ORDERED PHASES OF THE TYPE Ni_8X. van der Wekken, C. J.; Larson, J. M.; Taggart, R.; Polonis, D. H. (Univ. of Washington, Seattle). J. Appl. Phys.; 43: No. 11, 4522-31(Nov 1972).

Superdislocations comprising a group of three (1/2)a ⟨110⟩ dislocations lying in a close-packed plane were observed in ordered face-centered-tetragonal Ni_8Ta and Ni_8Nb alloys. The antiphase boundary (APB) energies of the areas between the dislocations were evaluated for Ni_8Ta in terms of the first- and higher-order nearest-neighbor atom pairs associated with the introduction of the dislocations in the ordered material. Values for the pair interaction were calculated by employing a polar model for the ordering and a long-range oscillatory atomic pair interaction energy. The results indicate that higher than first nearest-neighbor interactions account for approximately 40% of the total ordering energy. The critical temperature of Ni_8Ta was estimated on the basis of Cowley's ordering theory and the calculated values of the pair interaction energies. The theoretical value for the critical temperature is within 12% of the value that was determined by experiment. (auth)

16444 MAGNETIC MOMENT OF SMALL INDIUM PARTICLES IN THE QUANTUM SIZE-EFFECT REGIME. Meier, F.; Wyder, P. (Univ. of Nijmegen, Netherlands). Phys. Rev. Lett.; 30: No. 5, 181-184(29 Jan 1973).

The magnetic moment of small indium particles with a diameter of $d \simeq 50$ Å embedded in paraffin was measured between 1.5 and 4.2°K in magnetic fields up to 50 kG. A saturating paramagnetic moment was observed. However, the low saturation fields cannot be understood on the basis of existing theories on electronic quantum size effects. A simple model using orbital magnetism is presented which qualitatively accounts for the observations. (auth)

16445 ANALYSIS OF THE ELECTRICAL PROPERTIES OF BORON IN THE INTRINSIC CONDUCTION REGION. Berezin, A. A.; Golikova, O. A.; Khomidov, T. (Inst. of Semiconductors, Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 3, 470-471(Sep 1972).

Translated from Fiz. Tekh. Poluprov.; 6: No. 3, 545-547(Mar 1972).

β-rhombohedral boron resembles an amorphous semiconductor whose transport phenomena are described by the density of states. An approximate determination of the density of states and the carrier mobility in zone-melted β-boron in the intrinsic conduction region is made from the temperature dependences of electric conductivity, thermoelectric power, and Hall coefficient. The forbidden band width is $E_g = 1.23 \pm 0.02$ eV at 625 to 1250°K. The ratio of mobilities u_p/u_n falls from 8.4 at 625°K to 4.4 at 1250°K. (DLC)

16446 MAGNETIC PROPERTIES OF $HoFe_3$. Simmons, M. (Univ. of Missouri, Rolla); Moreau, J. M.; James, W. J.; Givord, F.; Lemaire, R. J. Less-Common Metals; 30: 75-82(1973).

The magnetic structure of $HoFe_3$ was determined by powder neutron-diffraction techniques. The moments of the holmium and the iron atoms are colinear, ferrimagnetically coupled, and parallel to the basal plane of the hexagonal structure. X-ray diffraction of the powder, oriented in a magnetic field, showed that the easy direction of magnetization is the b-axis. Molecular field coefficients and average exchange fields for holmium and iron atoms were calculated from the thermal variation of the magnetization and the paramagnetic susceptibility. The interactions between iron atoms were strong, whereas the holmium–holmium and holmium–iron interactions were weak. (auth)

16447 STRUCTURE OF α-UO_3 BY NEUTRON AND ELECTRON DIFFRACTION. Greaves, C.; Fender, B. E. F. (Oxford Univ.). Acta Crystallogr., Sect. B; 28: No. 12, 3609-3614(1972).

The structure of α-UO_3 was re-examined by neutron and electron diffraction. Analysis of the intensity of the neutron Bragg reflexions indicates that 12 ± 1% of the uranium sites are vacant in a disordered manner that neighboring U–O distances along the uranium-oxygen chains are shortened to 1.64 ± 0.04 Å. Earlier descriptions of the structure are inadequate, and it is shown that the average subcell contents are similar to those expected for uranium-deficient α-U_3O_8. The results explain earlier density and infrared observations. The superlattice reflexions observed in both neutron- and electron-diffraction patterns can be indexed on an orthorhombic unit cell with dimensions $a_0 = 6.84$, $b_0 = 43.45$, $c_0 = 4.157$ Å. There is a strong resemblance between the structures of α-UO_3 and L-Ta_2O_5. (auth)

16448 ELECTRON SPECTRUM AND PHYSICAL PROPERTIES OF THE DIBORIDES OF TITANIUM, VANADIUM, AND CHROMIUM. Samsonov, G. V.; Goryachev, Yu. M.; Kovenskaya, B. A.; Tel'nikov, E. Ya. (Inst. of Problems in Material Studies, Kiev). Izv. Vyssh. Ucheb. Zaved., Fiz.; No. 6, 37-42(1972). (In Russian).

Lines in the energy spectrum of TiB_2, VB_2, and CrB_2 were tabulated together with the numerical contribution of the metal and boron atomic orbitals to the molecular orbital. The donor ability decreased from the diboride of Group IV to V and VI. In the conversion of a metal from the free state to a diboride an electron rearrangement occurred: $s^2d^n \rightarrow s^{2-x}d^{n-y}$. The following properties of AlB_2, TiB_2, VB_2, and CrB_2 were compared: melting point, coefficient of thermal expansion, thermal conductivity, microhardness, heat of formation, work function, wetting angle on molten Cu, and the density of electron states. (KSW)

16449 ELECTRICAL AND MAGNETIC PROPERTIES OF $V_{1-x}W_xO_2$, $O \leq x \leq 0.060$. Hoerlin, T.; Niklewski, T.; Nygren, M. (Univ. of Stockholm). Mater. Res. Bull.; 7: No. 12, 1515-24(Dec 1972).

The semiconductor–metal transition in the phase $V_{1-x}W_xO_2$ ($O \leq x \leq 0.060$) has been studied by magnetic and electrical measurements over the temperature range 80 to 400°K. An average value of 3 Bohr magnetons per W atom was found for the semiconducting low-temperature phase. Electric-conductivity measurements on single crystals gave an activation energy of 0.096 eV in the region $0.006 \leq x \leq 0.052$. (auth)

16450 STRUCTURAL AND MAGNETIC STUDIES ON $DyFe_2$–$DyAl_2$ AND $DyCo_2$–$DyAl_2$. Oesterreicher, H.; Pitts, R. (Oregon Graduate Center, Beaverton). J. Appl. Phys.; 43: No. 12, 5174-80(Dec 1972).

Both pseudobinary systems are constituted of broad homogeneous regions of cubic and hexagonal Laves-phase type. Ordering tendencies on crystallographic sites between Al and the transition metal are studied in the hexagonal type. Magnetic investigations are carried out only in the ordered regime. It is found that electron transfer from Al to the transition metals quenches their moments to the effect that they become nonmagnetic at high Al concentrations. At cryogenic temperatures the magnetization behavior of powdered specimens is complex in the intermediate region of concentration. Considerable magnetic hardness and anisotropy develops, and in $DyFe_2$–$DyAl_2$ pronounced spontaneous increases in magnetization with field occur as a result of the presence of highly energetic domain walls. The complex interplay of effects from disordered magnetic components, the crystalline electric field, and domain-wall effects are discussed and compared findings in related systems. (auth)

16451 MUONIUM IN SILICON AND GERMANIUM: A DEEP DONOR. Wang, J. S. Y.; Kittel, C. (Univ. of California, Berkeley). Phys. Rev., B: 7: No. 2, 713-18(15 Jan 1973).

The hyperfine splitting of muonium in Si and Ge is analyzed on various models of the dielectric properties of the medium. Muonium acts as a deep donor in Si and Ge, contrary to some earlier predictions. It is possible to give a reasonable account of the observed values of $|\psi(0)|^2$ in terms of the Reiss–Kaus cavity models, and in terms of the Walter–Cohen $\epsilon(q)$ calculated from the actual band structures, provided that the electron mass is taken as essentially equal to the free-electron mass. Identical results are expected for interstitial atomic hydrogen. (auth)

16452 KINETICS AND THERMODYNAMICS OF THIN-FILM DEPOSITION BY MOLECULAR BEAM METHODS. I. ADSORPTION AND CLUSTERING OF CADMIUM ON GERMANIUM SINGLE CRYSTALS. Voorhoeve, R. J. H.; Carides, J. N.; Wagner, R. S. (Bell Telephone Labs., Murray Hill, N. J.). J. Appl. Phys.; 43: No. 12, 4876-85(Dec 1972).

The use of mass-spectrometric molecular beam techniques allowed a detailed study to be made of the kinetics and thermodynamics of thin-film deposition. Thermal accommodation, adsorption, nucleation, growth, and evaporation were measured for a single system. The deposits were characterized by their coverage-dependent steady-state evaporation rate, which is directly related to the thermodynamic potential of the evaporant in the film. The methods used and results obtained are exemplified by the present study of all stages of the ultrahigh-vacuum (UHV) deposition of cadmium on the (100), (110), (111), (211), and (331) faces of germanium. In this paper, the initial stages of adsorption and clustering are described. The thermal accommodation coefficient was found to be between 0.8 and 1.0. On (111) substrates, adsorption of one monolayer of immobile cadmium atoms precedes nucleation of bulk cadmium. On the other substrates, 40% to 70% of a monolayer is adsorbed prior to nucleation. The extent of this adsorption is predictable from the structure of the germanium surfaces. Adsorption energies range from 25 to 32 kcal/g atom, compared with a heat of sublimation of 26.7 kcal/g atom. The kinetics of the desorption of cadmium during deposition is in agreement with an evaporation mechanism in which desorption of mobile single cadmium adatoms is the rate-determining step. The desorption energy of mobile adatoms is approximately 12 kcal/g atom in the nucleation stage. It is shown that the stability of the cadmium deposit increases only slowly after nucleation. Electrically active dopants in the germanium increase the extent of cadmium adsorption which precedes nucleation. (auth)

16453 KINETICS AND THERMODYNAMICS OF THIN-FILM DEPOSITION BY MOLECULAR BEAM METHODS. II. NUCLEATION, GROWTH, AND EVAPORATION OF CADMIUM ON GERMANIUM SINGLE CRYSTALS. Voorhoeve, R. J. H.; Carides, J. N.; Wagner, R. S. (Bell Telephone Labs., Murray Hill, NJ). J. Appl. Phys.; 43: No. 12, 4886-4900(Dec 1972).

A study was made of all stages of the deposition of thin films of cadmium on germanium single crystals with (100), (110), (111), (211), and (331) orientations. In the preceding paper, adsorption phenomena were examined in detail. This paper gives the results on the kinetics and thermodynamics of the nucleation and growth stages and of the evaporation of cadmium from the deposit. In addition, the morphology of the films is described. Nucleation occurs on a composite germanium–cadmium substrate and proceeds until almost two monolayers have been deposited. The thermodynamic properties of the deposit during nucleation and growth have been obtained. The thin film can be characterized by a steady-state evaporation rate ν_e. The critical incident flux necessary for nucleation of bulk cadmium is directly related to the maximum which ν_e attains during early deposition. Nucleation is easiest on planes which are rough on the atomic scale and becomes more difficult in the order (110) $\lesssim$ (331) < (211) < (100) $\lesssim$ (111). The "liquid-drop" model of classical nucleation theory is inadequate to explain the results. A mechanism of nucleation and growth and of evaporation is given based on the kinetic data. The evaporation coefficient was found to be between 0.82 and 0.98. Defects and dopants in the substrate had only a minimal effect on nucleation and growth kinetics. (auth)

16454 MAGNETIC STRUCTURE OF THE COMPOUND DyNi. Gignoux, D.; Shah, J. S. (Centre National de la Recherche Scientifique, Grenoble, France). Solid State Commun.; 11: No. 12, 1709-1711(15 Dec 1972).

From magnetization measurements at 1.6°K, it was observed that the DyNi compound exhibits narrow domain walls frozen by the anisotropy. The non-collinear magnetic structure of this compound was studied by neutron diffraction techniques. Its magnetic structure is isomorphous to that of HoNi belonging to the space group Pnm'a'. (auth)

16455 ITERATIVE EXTENDED HUCKEL CALCULATION ON HEXAGONAL BORON NITRIDE. Zunger, A. (Tel Aviv Univ., Israel). Solid State Commun.; 11: No. 12, 1727-1730(15 Dec 1972).

Some properties of two-dimensional boron nitride are treated in a truncated crystal approach, employing the iterative extended Huckel method in a charge self-consistent calculation. The values of the band width, band gap, charges, equilibrium distance, and sublimation energy are in satisfactory agreement with experiment. (auth)

16456 CONCENTRATION DEPENDENCE OF GALVANOMAGNETIC PROPERTIES OF TUNGSTEN–RHENIUM ALLOYS IN SOLID SOLUTIONS. Bykov, V. N.; Budagovskii, S. S.; Kondratenko, Yu. V.; Chelnakov, N. P. Fiz. Metal. Metalloved.; 33: No. 2, 257-61(Feb 1972). (In Russian).

The specific electrical resistance, Hall constant, and magnetic resistance of W–Re solid solutions were measured. In concentration dependencies of specific resistance and Hall constant in the same concentration region, anomalies occurred that were apparently associated with the fact that the scattering potential of Re atoms in the solid solution lattice of W–Re did not remain constant and changed with concentration. (tr-auth)

16457 INFLUENCE OF STRUCTURE ON THE SPECIFIC RESISTANCE AND HALL CONSTANT OF SOLID SOLUTIONS OF TUNGSTEN–RHENIUM. Budagovskii, S. S.; Bykov, V. N.; Gavrilyuk, M. I.; Pod'yachev, V. N.; Chelnakov, N. P. Fiz. Metal. Metalloved.; 33: No. 2, 431-4(Feb 1972). (In Russian).

The phase diagram for the W–Re system was prepared up to ~3400°C. The concentration dependence of the Hall constant and of the specific resistance in alloys up to ~26% Re were measured. Different annealing schedules prior to such measurements revealed the influence of deformation, dislocations, and ordering on these parameters. (KSW)

16458 MAGNETIC STRUCTURE OF THE TmNi COMPOUND: CRYSTAL FIELD EFFECT. Gignoux, D. (CNRS, Grenoble, France); Rossat-Mignod, J.; Tcheou, F. Phys. Status Solid (a); 14: No. 2, 483-488(16 Dec 1972).

The TmNi compound crystallizes in the FeB-type structure (space group Pnma) where the Tm^{3+} ions occupy a very low symmetry site (m). Below its Curie temperature (7°K), TmNi shows a ferromagnetic behavior. From neutron-diffraction studies at 1.3°K, a noncollinear magnetic structure of this compound is deduced. The exchange energy is small with respect to the total crystal field splitting of the ground multiplet J. With a point-charge model, the crystal field parameters are calculated and the direction and magnitude of the magnetic moments of the Tm^{3+} ions in each site are determined. The good agreement between experimental results and calculations confirms the predominance of the crystal field in determining the magnetic structure of this compound. (auth)

16459 ELECTRICAL RESISTIVITY OF UAsY SINGLE CRYSTALS (Y = S, Se, Te). Wojakowski, A.; Henkie, Z.; Kletowski, Z. (Inst. for Low Temperature and Structure Research, Wroclaw). Phys. Status Solid (a); 14: No. 2, 517-520(16 Dec 1972).

The results of electrical resistivity measurements on single crystals of UAsY-type compounds in the temperature range from 4.2 to 650°K and in an electric field perpendicular to the [001] axis are presented and discussed. (auth)

16460 MAGNETIC PROPERTIES OF SOME CUBIC URANIUM COMPOUNDS. Suski, W. (Inst. for Low Temperature and Structure Research, Wroclaw); Mydlarz, T.; Rao, V. U. S. Phys. Status Solid (a); 14: No. 2, K157-160(16 Dec 1972).

Magnetization measurements were performed on UTe, U_3Te_4, and U_3Se_4 at temperatures from 4.2°K to above the magnetic transition temperature and in fields up to 80 kOe. UTe shows considerable remanence, and its Curie point is 102°K. U_3Te_4 does not attain magnetic saturation, but the magnetic moment (1.20 μ_B per U atom) is very close to that for UTe. The magnetization of U_3Te_4 shows a maximum at 10°K for fields up to 25 kOe. The magnetization of U_3Se_4 has a maximum at 35°K. (DLC)

16461 ^{133}Xe DIFFUSION AND TRAPPING IN SINGLE-CRYSTAL URANIUM DIOXIDE. Carter, J. C.; Driscoll, E. J.; Elleman, T. S. (North Carolina State Univ., Raleigh). Phys. Status Solid (a); 14: No. 2, 673-680(16 Dec 1972).

The diffusion of ^{133}Xe in single-crystal UO_2 was studied following the recoil injection of the ^{133}Xe from an external fissionable source. This technique was selected to minimize the diffusion anneals. Gas release results consistent with classical diffusion solutions were obtained over the entire heating cycle for each release curve and no "burst effect" was observed. The results were con-

sistent with $D = 2.88 \times 10^3 \exp[(-4.78 \pm 0.15)\ eV/kT]\ cm^2\ s^{-1}$ over the temperature range 1065 to 1300°C. Increasing the recoil concentration to 3×10^{12} fission fragments cm^{-2} (3×10^{-8} fission atom fraction) produced anomalies in the gas release curves which probably resulted from gas-atom trapping. Using parameters measured elsewhere for rare gas trapping in UO_2 and CaF_2, it was shown that many of the rare gas diffusion coefficients reported in the literature for UO_2 appear to be too low as a consequence of gas-atom trapping. (auth)

16462 LATTICE SPACINGS AND MAGNETIC SUSCEPTIBILITIES OF PALLADIUM–LANTHANUM, PALLADIUM–CERIUM, AND PALLADIUM–PRASEODYMIUM ALLOYS. Speight, J. D. (California Inst. of Tech., Pasadena). J. Less-Common Metals; 30: 159-63(1973).

Pd-rich Pd–La, Pd–Pr, and Pd–Ce alloys were prepared by rapid quenching. Lattice spacings of Pd–La (2–8%) and Pd–Pr (2–8%) alloys show no variation with rare-earth content, while that of Pd–Ce (2–8%) vary linearly with Ce content. Below 100°K, the susceptibility of Pd–4% Pr is greater than that of Pd–Ce and Pd–La and furthermore increases rapidly with decreasing temperature below 50°K. Results suggest that the 4f states of Ce in α–Pd are not occupied and therefore the effective valency of Ce in solid solution is four. The corrected susceptibility $\chi_{Pd-Pr} - \chi_{Pd-La}$ of the Pd–4% Pr alloy follows the Curie law at 0 to 100°K, and the effective magnetic moment of the Pr atoms is 3.28 μ_B, close to the value for trivalent Pr (3.58 μ_B). (DLC)

16463 PRODUCTION AND CHARACTERIZATION OF V_2O_3 SINGLE CRYSTALS BY VAPOR-PHASE TRANSPORT. Pouchard, M.; Launay, J. C. (Univ., Bordeaux). Mater. Res. Bull.; 8: No. 1, 95-104(Jan 1973). (In French).

Single crystals of V_2O_3 are obtained by HCl or $TeCl_4$ chemical transport method in sealed quartz tubes with temperature gradients of 1050 to 930°C and 990 to 900°C, respectively. The hexagonal prims are 5 mm long and 1 or 2 mm wide. Both kinds of crystals are characterized by sharp insulator–metal transition at 156 and 137°K, respectively; they present a large hysteresis. The sharp decrease in resistivity with increasing temperature is of the order of 10^8 at the transition. (auth)

16464 FERRITES. Proceedings of the International Conference, Kyoto, Japan, July 6–15, 1970. Hoshino, Y.; Iida, S.; Sugimoto, M. (eds.). Baltimore; University Park Press (1971). 709p. $36.00. (CONF-700730).

About 170 papers are included, which are arranged into 15 chapters: diffusion and magnetic relaxation, physical studies of magnetism of ferrites, preparation of ferrite materials, crystal chemistry of ferrites, soft ferrites, hard ferrites, growth of single crystals, ferrites for recording heads, bubble domain technology, magneto-optics and memory applications, memory materials and devices, magnetic recording tapes, microwave ferrites, oxides with metallic conduction states, and semiconducting magnetic chalcogenides. Separate abstracts were prepared for three of the papers from the next-to-last chapter. (DLC)

For abstracts of individual papers see: 16465–16467.

16465 METAL–INSULATOR PHASE TRANSITION IN V_nO_{2n-1}. Kachi, S.; Takada, T.; Bando, Y.; (and others) (Kyoto Univ.). pp 563-567 of Ferrites. Hoshino, Y. (ed.). Baltimore; University Park Press (1971).

From International Conference on Ferrites; Kyoto, Japan (Jul 1970). CONF-700730–.

Research on the phase relation in the V_2O_3–V_2O_4 system confirmed that the following nine phases exist below 1400°K: V_2O_3, V_3O_5, V_4O_7, V_5O_9, V_6O_{11}, V_7O_{13}, V_8O_{15}, V_9O_{17}, and VO_2 (generally expressed by V_nO_{2n-1}). The equilibrium oxygen partial pressure vs temperature relation in this system also confirmed the presence of this homologous series. Electron diffraction study suggested that these belong to the "Shear Structure." Magnetic (magnetic susceptibility, Moessbauer effect) and electric (electrical conductivity, thermoelectric power) properties were also examined with single crystals, which were prepared by a chemical transport reaction. As a result, it was revealed that these phases show a transition from a high-temperature metallic phase to a low-temperature semiconductive phase. (33 references) (auth)

16466 ELECTRICAL AND MAGNETIC PROPERTIES RELATED TO DEFECT STRUCTURE IN THE NONSTOICHIOMETRIC TiO AND VO PHASES. Suzuki, K.; Takeuchi, S. (Tohoku Univ., Sendai). pp 568-572 of Ferrites. Hoshino, Y. (ed.). Baltimore; University Park Press (1971).

From International Conference on Ferrites; Kyoto, Japan (Jul 1970). CONF-700730–.

X-ray and neutron diffractions, electrical resistivity, magnetic susceptibility, Hall coefficient, and Knight shift were measured as a function of composition or temperature for the TiO and VO phases. It is considered that the large amount of randomly distributed vacancies in these phases was not produced by thermal excitation but resulted from the internal energy gain which was ascribed to the formation of a metallic band due to the extreme contraction of lattice parameters. The maximum internal energy gains were calculated as about 1 eV for both phases. In a tentative model of the energy band structure for these phases, the Fermi energy was placed at the concave part in the density of states versus the energy curve, where the overlap of the bottom of the 3d-conduction band and the top of band owing to the 3d electrons trapped at oxygen vacancies was strongly expected. (auth)

16467 STRUCTURAL, ELECTRICAL, AND MAGNETIC PROPERTIES OF TiO, VO, AND NbO. Reed, T. B.; Banus, M. D.; Goodenough, J. B.; Strauss, A. J.; Pollard, E. R. (Massachusetts Inst. of Tech., Cambridge). pp 573 of Ferrites. Hoshino, Y. (ed.). Baltimore; University Park Press (1971).

From International Conference on Ferrites; Kyoto, Japan (Jul 1970). CONF-700730–.

The electrical, magnetic, and superconducting properties of TiO_x and VO_x are presented as a function of x and T. Results suggested that TiO and NbO are metallic for all x, while VO is a metal or semimetal for $x < 1.00$ and a semiconductor for $x > 1.00$. (DLC)

16468 PROTON SPIN LATTICE RELAXATION TIME IN B. C. C. Ti–Mo–H ALLOYS. Zogal, O. J. (Inst. of Low Temperature and Structure Research, Wroclaw); Stalinski, B.; Froehlich, F. Cryst. Lattice Defects; 3: No. 4, 207-211(Nov 1972).

The proton spin–lattice relaxation time T_1 was measured for two nonstoichiometric compounds $Ti_{0.46}Mo_{0.54}H_{0.59}$ (No. 1) and $Ti_{0.57}Mo_{0.43}H_{0.95}$ (No. 2) as a function of temperature between 173°K and 373°K. A minimum found for T_1 can be attributed to thermally activated diffusion of the hydrogen atoms. From the temperature dependence of T_1, the corresponding activation energies were calculated: 4.04 (No. 1) and 4.66 (No. 2) kcal/mole. A comparison of experimental and theoretical $(T_1)_{min}$ values allows conclusions on the structure of the hydrogen sublattice. (auth)

16469 MAGNETIC PROPERTIES OF CARBIDES OF TRANSITION METALS. Grebenkina, V. G. (Inst. of Problems in Material Studies, Kiev). Porosh. Met., Akad. Nauk Ukr. SSR; No. 11, 73-78(Nov 1972). (In Russian).

Data on magnetic susceptibility of transition metals of groups IV–VI and their carbides were considered at room temperature and in the range of 0 to 1000°C. Paramagnetism of the metals and carbides is established to be chiefly due to the Pauli paramagnetism of conduction electrons. The change in paramagnetism with temperature in metals of group IV is connected with the effect of the Van Fleck orbital paramagnetism, and in metals of group V and their carbides with a decrease in effective masses of carriers. (auth)

16470 EMISSION SPECTRUM OF PrO. Venkitachalam, T. V.; Krishnamurty, G.; Narasimham, N. A. (Bhabha Atomic Research Center, Trombay, India). Proc. Indian Acad. Sci., Sect. A; 76: No. 3, 113-120(Sep 1972).

The bands of PrO at 8488.95 A and 7986.44 A of system I and at 7662.85 A of system III were photographed on a 6.6-m concave grating spectrograph at a dispersion of 1.2 A/mm and their rotational structure analyzed. They are assigned transitions from $v' = 0$ and 1 levels of $A^2\Delta_{\frac{1}{2}}$ and $v' = 0$ level of $B^2\Delta_{\frac{1}{2}}$ to a common $v'' = 0$ level of the ground, $X^2\Pi_{\frac{1}{2}}$ state. (auth)

16471 MAGNETIC PROPERTIES OF RARE EARTH METALS. Elliott, R. J. (ed.). New York; Plenum Publishing Corporation (1972). 431p. $28.00.

This book summarizes the general pattern of the magnetism of rare earths and its theory. The eight chapters are titled: introduction; phenomenological theory of magnetic ordering; magnetic structures; bulk magnetic properties; spin waves; energy band structure; indirect exchange interactions and magnetic ordering; transport properties, and hyperfine interactions. Each chapter has its own extensive bibliography, and a subject index is provided at the end. Separate abstracts were prepared for the last seven chapters. (DLC)

For abstracts of individual chapters see: 16472–16478.

16472 PHENOMENOLOGICAL THEORY OF MAGNETIC ORDERING: IMPORTANCE OF INTERACTIONS WITH THE CRYSTAL LATTICE. Cooper, B. R. (General Electric Research and Development Center, Schenectady, NY). pp 17-80 of Magnetic Properties of Rare Earth Metals. /Elliott, R. J. (ed.). New York; Plenum Publishing Corp. (1972).

The theory that describes the magnetic behavior of the localized

(4f) moment system is the phenomenological theory. The theory of magnetic ordering, i.e., understanding of the equilibrium magnetic arrangements and transitions between them is discussed. The role played by crystal-electric-field effects in rare earth magnetism is considered, and experimental measurements of the size of crystal-field effects are discussed. (28 figures, 118 references) (DLC)

16473 MAGNETIC STRUCTURES OF RARE EARTH METALS AND ALLOYS. Koehler, W. C. (Oak Ridge National Lab., TN). pp 81-128 of Magnetic Properties of Rare Earth Metals. /Elliott, R. J. (ed.). New York; Plenum Publishing Corp. (1972).

A review is given of the magnetic structures of the rare earths and certain of its alloys, as determined by neutron diffraction and magnetization measurements. The pure metals and the alloys of the heavy rare earths with each other and with the diamagnetic diluents Y and Th are covered, with emphasis on results obtained in the past five years. Form factor measurements by polarized beam methods are discussed. (24 figures, 109 references) (DLC)

16474 BULK MAGNETIC PROPERTIES. Rhyne, J. J. (Naval Ordnance Lab., Silver Spring, MD). pp 129-85 of Magnetic Properties of Rare Earth Metals. /Elliott, R. J. (ed.). New York; Plenum Publishing Corp. (1972).

A review is presented of the static magnetic properties of heavy and light rare earths Single-crystal results are reviewed where available to the exclusion of polycrystalline data. Magnetization, susceptibility, magnetic anisotropy, magneto-elastic properties, and specific heat are considered in turn. (6 tables, 37 figures, 119 references) (DLC)

16475 SPIN WAVES. Mackintosh, A. R. (Univ. of Copenhagen); Moeller, H. B. pp 187-244 of Magnetic Properties of Rare Earth Metals. /Elliott, R. J. (ed.). New York; Plenum Publishing Corp. (1972).

A review is presented of the knowledge of spin waves (magnons) in the rare earth metals, especially the hcp heavy rare earths, and of their interpretation to elucidate the magnetic interactions and magnetically ordered structures. Recent measurements on Pr are also described briefly. (28 figures, 80 references) (DLC)

16476 ENERGY BAND STRUCTURE, INDIRECT EXCHANGE INTERACTIONS, AND MAGNETIC ORDERING. Freeman, A. J. (Hebrew Univ., Jerusalem). pp 245-333 of Magnetic Properties of Rare Earth Metals. /Elliott, R. J. (ed.). New York; Plenum Publishing Corp. (1972).

A review is presented of the present knowledge of the electronic properties of the rare earth metals as derived from band theory. After a description of the electronic band structures and Fermi surfaces of heavy and light rare earth metals, the Ruderman–Kittel–Kasyua–Yosida interaction and the effects of magnetic superzones on Fermi surfaces are discussed. The relation of the magnetic ordering to the actual band structures and Fermi surfaces is discussed. The origin of crystal fields in the rare earths is discussed briefly. (42 figures, 157 references) (DLC)

16477 TRANSPORT PROPERTIES. Legvold, S. (Ames Lab., IA). pp 335-81 of Magnetic Properties of Rare Earth Metals. /Elliott, R. J. (ed.). New York; Plenum Publishing Corp. (1972).

This review begins with electrical resistivity and thermal conductivity measurements on single crystals of the heavy rare earths and Y. Seebeck coefficients of the heavy rare earths and Y are then covered, followed by the electrical resistivity, thermal conductivity, and Seebeck coefficients of the light elements and Yb. The simplified magnetic superzone theory is applied to the electrical resistivity. Finally, Hall effect measurements are described. (29 figures, 77 references) (DLC)

16478 HYPERFINE INTERACTIONS. Bleaney, B. (Oxford Univ.). pp 383-420 of Magnetic Properties of Rare Earth Metals. /Elliott, R. J. (ed.). New York; Plenum Publishing Corp. (1972).

The simple theory of magnetic hyperfine structure of an atom or ion in a state of $4f^n$, L, S, J, is outlined. Calculation of nuclear moments, magnetic hyperfine constants for "isolated" ions, and electric quadrupole hyperfine interaction is discussed. Experimental methods (NMR, Moessbauer effect, hyperfine specific heat, etc.) and results are discussed. (11 tables, 86 references) (DLC)

Moessbauer Effects and NMR

Refer also to abstract 14841.

16479 DETERMINATION OF HYPERFINE INTERACTIONS FROM PARTLY RESOLVED MOESSBAUER SPECTRA. Gerdau, E.; Raeth, W.; Winkler, H. (Univ., Hamburg). Z. Phys.; 257: No. 1, 29-42(1972).

Moessbauer spectra with different sets of parameters were calculated. A fit with a superposition of Lorentzians to these theoretical spectra showed that systematic errors must be expected if the hyperfine structure of the spectrum is only partly resolved. Correction factors for some simple cases are given. Experiments to test the calculations were performed with ^{133}Cs (81-keV transition), ^{165}Ho (94.7-keV transition), and ^{178}Hf (93-keV transition). In all cases fits using the transmission integral and superpositions of Lorentzians showed the expected trends. The following results were obtained: ^{133}Cs: $(g_{ex}/g_{gr}) = 1.90(4)$; ^{165}Ho: τ(94.7-keV level) = 32(1) ps, $(g_{ex}/g_{gr}) = 0.77(3)$; ^{178}Hf: $|H_{eff}$(4 K, in iron)| = 633(40) kG, $|H_{eff}$(77 K, in iron)| = 630(41) kG. (14 figures) (auth)

16480 DIAMAGNETIC KNIGHT SHIFT IN BERYLLIUM. Borchi, E.; De Gennaro, S. (Univ., Florence). Lett. Nuovo Cim.; 6: No. 3, 111-114(20 Jan 1973).

A negative Knight shift (−0.0026%) has been observed for Be. Diamagnetic contributions to the Knight shift are in agreement with the negative Knight shift. Some estimates are made of the diamagnetic susceptibility of Be and of the anisotropy of the Knight shift for Be. (DLC)

PHYSICS (THEORETICAL)

Refer also to abstracts 14932, 15945, 15981, 16327, and 16342.

16481 (IAE-2128) COMPARISON OF EXACT SOLUTIONS FOR TWO ONE-DIMENSIONAL MULTI-PARTICLE PROBLEMS WITH K-HARMCNICS METHOD APPROXIMATION. Pavlichenkov, I. M. (Institut Atomnoi Energii, Moscow (USSR)). 1971. 16p. (In Russian). INIS.

Precise solutions of the one-dimensional Schroedinger equation for a system of particles with paired δ-form interactions and for a system of particles in a δ-form potential well were compared with the null approximation of the K-harmonic method. It was shown that the K-harmonic method leads to better results for systems with large particle densities. The result obtained fell below the limit of accuracy of the method of K-harmonics, since the wave functions were completely symmetrical relative to particle rearrangement/permutation. (tr-auth)

16482 THERMODYNAMIC APPROXIMATION OF FERMION GREEN'S FUNCTIONS BY A VARIATIONAL PRINCIPLE. Froboese, Klaus (Univ., Goettingen, Ger.). Z. Phys.; 253: No. 3, 200-18(1972). (In German).

For field operators, A, B of Fermion type, variational principles are formulated. The stationary values of the functionals are equal to the Laplace transforms of the retarded and the advanced Green's functions $(1/i)\ \langle\{A(t), B^+\}\rangle$ for $t > 0$ and $-(1/i)\ \langle\{A(t), B^+\}\rangle$ for $t < 0$, respectively. From these functionals new ones are deduced, having extremal properties (a maximum and a minimum principle) and determining $\mathrm{Im}(1/i)\ \langle\{A(t), B^+\}\rangle$ at their extremal values. By the Ritz variational method the stationary principle is used to derive a prescription for approximating Green's functions. In the case of the BCS Hamiltonian, the very same results are obtained as the BCS theory without any further assumption about breaking the particle number invariance or introducing quasi averages. (auth)

16483 OPERATORS IN A RELATIVISTIC FOCK SPACE FOR FERMIONS. Marx, E. (Drexel Univ., Philadelphia). Int. J. Theor. Phys.; 6: No. 4, 301-306(Oct 1972).

The definition of creation and annihilation operators is extended for a particle in an arbitrary state in Fock space to the relativistic case. Special attention is paid to the metric in this space and to the phase convention that leads to anticommutation relations for these operators. The same conventions also apply in the case of several types of fermions. (auth)

16484 RAPID NUMERICAL SOLUTION OF THE ONE-DIMENSIONAL SCHROEDINGER EQUATION. Newman, W. I.; Thorson, W. R. (Univ. of Alberta, Edmonton). Can. J. Phys.; 50: No. 23, 2997-3022(1 Dec 1972).

It is shown that, contrary to common experience and opinion, the exact solutions to Schroedinger's equation in one dimension (or any similar ordinary linear second-order differential equation) can be numerically computed at a speed characterized by the variations of the potential function, i.e. at effectively the speed of solving Hamilton's equations. The method of solution depends upon the existence and calculation of certain "fundamental" and unique special solutions, closely associated with the JWKB series. These solutions have exponential form with exponents which are everywhere finite, nonoscillatory functions varying smoothly with the potential ("quantal action"); their existence does not seem to have previously been known. They are generated when a novel iterative technique is employed to solve certain Riccati equations. The expressions obtained appear to be asymptotic representations, but are numerically essentially convergent (error $< 1 \times 10^{-8}$) whenever the JWKB approximation is reasonably valid. Because the exponent function and its derivative ("quantal momentum") are smooth and slowly varying, this iteration can be used to generate initial values in asymptotic domains and rapid numerical integration of the Riccati equation for the quantal momentum then performed to compute the exact solutions everywhere. Because of the simple character of the solutions, a number of elegant and useful results in perfect analogy with the JWKB approximations for eigenvalue conditions (Bohr–Sommerfeld rule) and scattering phase shifts can be obtained. The method can be employed whenever the desired solution possesses more than two or three de Broglie oscillations over a region of significant variation of the potential. The method was investigated for a number of representative potential functions; it is found that it is always at least one order of magnitude faster than standard methods based on direct integration of the Schroedinger equation, and for those cases where it can be employed it is believed it will render them obsolete. (auth)

16485 LEVEL SPECTRUM OF THREE RESONANTLY INTERACTING PARTICLES. Efimov, V. (Inst. of Nuclear Physics, Leningrad). JETP Lett. (USSR) (Engl. Transl.); 16: No. 1, 34-7(5 Jul 1972).

Translated from Ah. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 1, 50-4(5 Jul 1972).

A quantum mechanical effect for the level spectrum of three particles is discussed for three spinless bosons, a negative molecular ion, and nuclei. (JFP)

16486 QUANTUM MECHANICS WITH A NONNEGATIVE DISTRIBUTION FUNCTION IN PHASE SPACE. Kuryshkin, V. V. Ann. Inst. Henri Poincare, Sect. A; 17: No. 1, 81-95(1972). (In French).

A quantum mechanics constructed using correspondence rules free from the defects existing in already established rules is presented. It is demonstrated that within this quantum mechanics, there exists a nonnegative phase space distribution function. The domain of coincidence between the theory obtained and the usual quantum mechanics and classical statistics are determined. (France)

16487 QUANTIZATION OF FERMI SYSTEMS AND THE DIRAC BRACKET. Kalnay, A. J. (Instituto Venezolano de Investigaciones Cientificas, Caracas); Ruggeri, G. J. Int. J. Theor. Phys.; 6: No. 3, 167-174(Oct 1972).

Some problems related to the quantization rule for constrained classical models of Fermi type are discussed, and a specific model which is a classical analog of the quantum Fermi systems is worked out with some detail. The quantization of this model is shown to depend on the addition of a total time derivative to the corresponding Lagrangian. (auth)

REACTOR TECHNOLOGY

Power Reactor Development

16488 (CONF-720662-1) FAST REACTORS IN BRITAIN. Campbell, R. H. (Nuclear Power Group Ltd., Knutsford (England)). Jun 1972. 18p. Dep. NTIS (U. S. Sales Only).

From Seminar on nuclear energy; Barcelona, Spain (6 Jun 1972).

Progress in the development of liquid metal cooled fast breeder reactors, from the operation of DFR to the present design of a 1300 MW(e) reactor is reviewed. The design and construction of PFR is described and illustrated with particular emphasis on primary coolant and tank, heat exchangers, fuel handling system and core support system. Certain departures from the PFR design, necessitated by increase in size and number of components, are discussed in describing the work in progress on the 1300 MW(e) design for the first commercial fast reactor. (UK)

16489 (JPRS-56318, pp 25-38) PLANNING ATOMIC ELECTRIC POWER STATIONS WITH STEAM-COOLED REACTORS. Kalafati, D. D.; Petrov, S. I.; Ignatov, V. V. Translated from Teploenergetika; No. 3, 88-92(1972).

A discussion is given in the development of superheating reactors. Included are both thermal and fast steam-cooled reactors. The work in various countries, especially U.S.A., is summarized. 26 references. (JMJ)

16490 (KFK-1272/2) FAST BREEDER PROJECT. Second Quarterly Report, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). Sep 1972. 226p. (In German). (EUR-4847). Dep. NTIS (U. S. Sales Only).

Investigations carried out for the fast breeder project by departments of the GfK in Karslruhe are described. The topics for investigation are: fuel rod development, materials testing and development, corrosion tests and coolants analysis, physical experiments, reactor theory, instrumentation and signal working for core control, consequences of reactor disturbances for the environment, release of radioactivity, sodium technology experiments, thermodynamic and hydrodynamic experiments in gas and steam, reactor design works concerning gas-cooled, steam-cooled and sodium-cooled breeder reactors. (GF)

16491 REACTOR DEVELOPMENT FOR NUCLEAR POWER STATIONS. Voigt, O.; Domin, G. Energ. Tech.; 24: No. 9, 275-82(1972). (In German).

Reactor development is reviewed, including a description and critical evaluation of realized reactor concepts as well as an outlook on future developments. Economical questions are treated as well as aspects of reactor safety and environmental exposure. The method and extent of governmental support in this field is described and compared with the support granted by other states for projects of this kind. (GF)

16492 WILL THE PEBBLE BED REACTOR BE RESCUED OR DIE OUT? Energie; 24: No. 9, 213-14(1972). (In German).

The public hearing is described that has been held at the Nuclear Research Center Juelich to discuss further steps to be taken within the framework of the high-temperature reactor projects. The purpose of these projects is to develop the high-temperature reactor with a helium turbine in the direct cooling circuit. One of the major problems to be solved within the near future is the question of whether the concept put forward by Gulf General Atomic, i.e., that of a high-temperature reactor with prismatic fuel elements, is to be given preference over that of the pebble bed reactor. (GF)

16493 FROM THE LWR VIA THE HIGH TEMPERATURE REACTOR TO THE FAST BREEDER. Energ. Tech.; 24: No. 9, 283-6(1972). (In German).

The general development trends in the field of nuclear reactors is outlined. The main features of the high-temperature reactor line are described. The AVR and THTR-300 are used as examples to illustrate the principles of this reactor type and its development potential. An essential improvement concerning burn-up and its control is expected by use of the OTTO (Once-through-then-out)-method. Various concepts of process heat utilization are reviewed. (GF)

Physics and Core Engineering

Refer also to abstract 16816.

16494 (CONF-701074-5) INTERNAL REACTOR START-UP MEASUREMENT AND OPERATION OF BLOCK II OF THE NOVOVORONEZHSKAYA AES. Lomakin, S. S.; Morozov, A. G.; Panfilov, G. G.; Petrov, V. I.; Popov, S. G.; Ovchinnikov, F. Ya.; Golubev, L. I.; Kruglov, V. P.; Vikin, V. A.; Galvoronskii, S. F. Translated from pp 412-24 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. I. 11p. Dep. NTIS.

The parameters of the thermal neutron field were investigated in the measuring channels. Measurements were made with activation detectors of the spectral characteristics and the relative distributions of the thermal neutron flux were measured also with fission chambers and direct charge sensors. Absolute measurements were made on the basis of the activation of thin gold foils. The spectrum and absolute neutron fluxes in the reactor core and around the shell were measured with threshold detectors. Experimental investigation showed the presence of altitude edge effect in the spectral distribution of the neutrons, which must be taken into consideration in measuring the distribution of energy release, and also permitted determining the integral fast neutron fluxes on the reactor shell, knowledge of which is important for its safe operation. (auth)

16495 (CONF-701074-7) STUDY OF THE PHYSICAL CHARACTERISTICS OF THE BOR-60 REACTOR. Kazachkovskii, O. D.; Alekseev, I. N.; Baranov, S. M.; Gadzhiev, G. I.; Gryazev, V. M.; Karatsuba, Yu. M.; Krasnoyarov, N. V.; Lychagin, V. N.; Fofanov, V. S. Translated from pp 504-24 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. I. 19p. Dep. NTIS.

Results are presented of critical experiments in the process of the startup of the BOR-60 reactor, measurement of the effectiveness of regulating devices and the spatial irregularity of energy release over the apparatus, and results of investigations of the various effects on reactivity of startup and operation at power. (auth)

16496 (CONF-701214, Paper No. 4) DEVELOPMENT OF ADVANCED FAST REACTORS IN THE U.S.A. Hermansky, Bedrich (Technical Univ., Prague). 20p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The U.S. fast reactors R & D programme is briefly characterized. Main attention is given to the SEFOR experimental reactor. Also mentioned are draft projects by General Electric, Westinghouse, Atomics International, and Argonne National Laboratory of fast reactors with a capacity of 1000 MW(e). (Nucl. Sci. Abstr. Czech.)

16497 (GULF-RT-A-10998) FAST REACTOR SPECTRUM MEASUREMENTS. Technical Summary Report, February 1, 1971-January 31, 1972. Young, J. C.; Neill, J. M.; Verbinski, V. V. (Gulf Radiation Technology, San Diego, Calif.). 30 Oct 1972. Contract AT(04-3)-167. 80p. Dep. NTIS.

Configuration details of assemblies STSF-9 and -10 are presented. Auxiliary neutron spectrum studies including room return effects, which were shown to be negligible, are described. This has particular significance since the assemblies show more neutrons in the keV region than are predicted and the problem is believed to be inadequacies in the inelastic scattering cross section data for ^{238}U. The time-of-flight spectrum measurements and reactor calculations are discussed. A summary of the studies with proton-recoil counters is given. The research done with a ^{3}He solid state spectrometer that did not achieve the desired objective is reviewed. Some additional calculational studies of control rod effects are presented. (37 references) (auth)

16498 (NEIC-RR-48) FAST BREEDING REACTORS. Bibliography 1969-1970. Kowalski, A.; Oleszczak, A. (comps.) (Nuclear Energy Information Center, Warsaw (Poland)). 1972. 143p. Dep. NTIS (U. S. Sales Only).

The bibliography includes 1135 references registered in Nuclear Science Abstracts of Poland Vol. 24 in 1970. A subject index and reactor index are presented. (auth)

16499 SPECTRAL INDICES FOR FAST REACTORS. Ohta, M. (Kyushu Univ., Fukuoka); Nakagawa, K.; Nishihara, H. Kyushu Daigaku Kogaku Shuho; 45: No. 3, 312-16(Jun 1972). (In Japanese).

Various spectral indices were defined. They were α-values for ^{239}Pu, ^{241}Pu and $\gamma = [N(238)\ \bar{\sigma}_c(238)]/[N(239)\ \bar{\sigma}_f(239)]$. α is the ratio of neutron capture to fission. σ_c is the capture cross section and σ_f is the fission cross section. These values and the internal breeding ratio (IBR) were calculated for the spherical core of 3000 liters with varying conditions such as volume ratio, plu-

tonium isotopic composition and fuel types of oxide and carbide. The calculation was performed by using the YOM cross section set. The relation between those indices and IBR is shown. The results indicate that the relation between IBR and individual α cannot be represented by a single curve, but it can be represented by separate curves depending on the fuel type and the plutonium isotopic composition. However, if the plutonium isotopic composition is the same, the relation between IBR and γ can be represented by a single curve which is almost linear. (Japan)

16500 ADJUSTMENT OF A BURN-UP CODE ON CHEMICAL AND ISOTOPIC ANALYSES OF IRRADIATED FUELS. Luffin, J.; Szatmary, Z.; Vanuxeem, J. (CEN de Saclay, Gif-sur-Yvette, France). J. Nucl. Energy; 26: No. 12, 627-641(Dec 1972).

In studying the change in the contents of heavy nuclei (^{236}U, ^{239}Pu, ^{240}Pu, ^{241}Pu) of fuels irradiated in natural uranium gas-cooled reactors, some of the characteristic parameters of the model need to be adjusted. The model used, the COREGRAF 2 code, solves the usual burnup equations. Neutron spectrum is calculated from the thermalization theory (Cadilhac's model). Chemical and isotopic analyses were made on samples taken from fuel extracted from French nuclear power plants. The parameters to be adjusted were chosen in relation with the experimental data: ^{238}U resonance integral and 2,200 m/s cross sections for ^{239}Pu capture, ^{240}Pu absorption, ^{241}Pu capture and ^{235}U capture. Two methods for this adjustment are presented. The first, which can be called a point method, uses analysis results and the global adjustment is reached by statistical processes. The second, which can be called a global method, treats the whole set of analysis results and leads directly to a global adjustment by a least square technique. Both methods give quite identical results and bring complementary information on the quality of the adjustment made by each other. The interest of the study lies more in the general character of the methods which are used, rather than on the results, which are strictly related to the model, and to the type of reactor. (auth)

16501 CHANGE OF SOME PARAMETERS WITH THE POWER OF PRESSURIZED WATER NUCLEAR REACTORS. Leca, Aureliu. Bul. Inst. Politeh. Gheorghe Gheorghiu-Dej Bucuresti; 33: No. 5, 111-26(1971). (In Rumanian).

The evolution of the main thermal and hydraulic parameters that characterize the core of pressurized water nuclear reactors is presented in terms of the nuclear-reactor thermal power. For certain calculation assumptions, the variation of the heat-flow rate in terms of the reactor power is studied, as well as power densities in the active zone, pressure loss in the technological channel, temperature increase in the core, etc. The conclusions are important for establishing similarity relations for the thermal and hydraulic dimensioning of pressurized water reactors. (auth)

16502 EBRFLOW: A COMPUTER PROGRAM FOR PREDICTING THE COOLANT FLOW DISTRIBUTION IN THE EXPERIMENTAL BREEDER REACTOR-II. Gopalakrishnan, A.; Gillette, J. L. (Argonne National Lab., IL). Nucl. Technol.; 17: No. 3, 205-216(Mar 1973).

The EBRFLOW program was developed for determining the detailed coolant flow distribution in the EBR-II primary system. A few pertinent results were obtained from the code. These include a determination of the changes in core pressure drop and flow distribution with core loading changes and a comparison of the measured and EBRFLOW-predicted flow rates through an instrumented subassembly for EBR-II runs 42-48E. (auth)

Control Elements, Systems, and Instrumentation

16503 (CONF-701074–10) MEASUREMENT OF THE SODIUM FLOW RATE AND LEVEL IN FAST POWER REACTORS. Taranin, V. D.; Petrenko, A. A.; Kuznetsov, I. A.; Danilov, M. A.; Loginov, I. I.; Tavrovskii, I. I.; Radchenko, V. A. Translated from pp 620-50 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5–10 October 1970, Vol. I. 25p. Dep. NTIS.

Questions of the precise measurement of the sodium flow rate by means of large electromagnetic flowmeters and also measurements of the sodium level at high temperatures at pressures of 0 to 6000 mm are examined. A schematic diagram is presented of a metrological flowmeter stand which permits testing magnetic flowmeters with an upper limit of measurement of 4000 m^3/hr of liquid sodium, and the main specifications for components of the stand are formulated. The design of a high-temperature sodium levelmeter is described and a schematic diagram is presented. The results of adjustment and resource tests of the instrument on the sodium stand of the BR-5 reactor are presented. (auth)

16504 (CONF-701214, Paper No. 29) FUEL ELEMENT DEFECTS DURING REACTOR OPERATION AND THEIR DETECTION IN VARIOUS REACTOR TYPES. Melichar, Zdenek; Hladky, Eduard (Power Research Inst., Jaslovske Bohunice, Czech.). 14p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

An outline is given of the requirements for a failed fuel detection system in power reactors, and descriptions of such systems are given for gas-cooled and water-cooled thermal reactors and fast reactors. The failed fuel detection system in the A-1 power station is based on mechanical collection of product isotopes of Rb and Cs, followed by measurement of their gamma activity with NaI(Tl) scintillation detectors. (Nucl. Sci. Abstr. Czech.)

16505 (RT/ING-(72)17) INSTRUMENTATION (NONNUCLEAR) FOR LIQUID METAL REACTORS: BIBLIOGRAPHIC RESEARCH FOR THE PERIOD 1960–1971. Pia, S. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 24 Jul 1972. 258p. (In Italian). Dep. NTIS (U. S. Sales Only).

A bibliography is presented on the non nuclear instrumentation for liquid metal cooled reactors, covering the period 1960–1971. The general aspects of instrumentation and the various methods and instruments (and related materials) for the measurement of sodium purity, pressure, temperature, flowrate, levels, stresses, detection, location, control, monitoring, surveillance, and corresponding testing, calibration and inspection facilities are considered. The problem of radiation effect on instruments and cables is considered. (auth)

16506 HYBRID SIMULATION OF NUCLEAR REACTOR PLANT. Oguri, K.; Ebizuka, Y. (Tokyo Inst. of Tech.). Bull. Tokyo Inst. Technol. (Engl. Ed.); No. 109, 41-56(Mar 1972).

A hybrid computer simulation was performed to investigate the feasibility of digital control systems for nuclear plants. A simple reactor system including neutron kinetics and fuel, moderator and coolant kinetics was examined. Coolant outlet temperature was controlled with a digital controller. Dynamic behavior of the control system depends strongly upon the choice of sampling period of the digital controllers. It was found that the sampling period which gives the stability limit is about 3.6 sec for a position-type controller and about 2.3 sec for a velocity-type controller. A hybrid computer affords an excellent means of simulating the dynamics of sampled data systems. The response of the systems to step reactivity disturbances and noise reactivity disturbances was simulated by the hybrid computer CLOAP 2000 of Tokyo Institute of Technology. The results were compared with the results of the stability analysis given above and showed good agreement. (Japan)

16507 NEW IDEAS ON FUNCTIONAL GROUP CONTROL FOR THE AUTOMATION OF POWER STATIONS. Ernecke, K. (Kraftwerk Union AG, Frankfurt am Main); Hinz, W. Elektrizitaetswirtschaft; 71: No. 19, 549-53(1972). (In German).

The present state of development of a control system for power stations is described, together with the associated installation planning and the application to nuclear power stations. A review is given of the continuous development of the system, which has been successfully used since 1966 for power station processes. The detailed reasons which led to the extension of the earlier plan are given. The overall design is presented with the results of this development. (GF)

16508 GIDRAVLIKA SU-Z YADERNYKH REAKTOROV. (Hydraulic Control and Protection Systems for Nuclear Reactors). Ionaitic, R. R.; Stobetskii, V. N. Moscow; Atomizdat (1972). 188p.

Various systems of control and protection designed for nuclear reactors are surveyed. Control rod motion, design of disconnect devices, the use of rotameters and other flow meters, and the design of hydraulic systems are included. Practical problems are solved, and application to nuclear reactors is of primary consideration. 246 references. (KSW)

16509 BREAKDOWN PULSE NOISE IN INSULATED SYSTEMS FOR LMFBR APPLICATION. Schemmel, R. R.; Philipp, L. D.; Stringer, J. L. (Hanford Engineering Development Lab., Richland, WA). Nucl. Technol.; 17: No. 3, 198-204(Mar 1973).

The mineral insulators, such as Al_2O_3, MgO and SiO_2, appear to possess satisfactory radiation tolerance and acceptable high temperature electrical properties for many nuclear applications. However, tests on practical cables for reactor instrumentation systems, and experiments to determine electrical properties of bulk materials, have revealed phenomena which limit applicable temperature ranges and dc voltage bias levels. For example, these materials exhibit a rapid decrease in electrical resistivity and a corresponding increase in low frequency dielectric constant with increasing temperature above some critical temperature. Also, cables employed for dc bias pur-

poses have exhibited a phenomenon, termed breakdown pulse noise (BPN), which has been a major obstacle to satisfactory operation of low-level fission counters for the FFTF since the BPN-generated pulses are indistinguishable from typical detector pulses. Careful voltage and temperature tests with both SiO_2 and MgO-insulated cables determined a useful region of operation as a function of insulator compaction density and purity. However, if insufficient care is taken in the preparation and design of cable end seals, the connector region of the cable may cause unsatisfactory performance even though the body of the cable satisfies test criteria. (8 references) (auth)

Cooling Systems

16510 (AREAEE-144) THERMAL DESIGN OF HEAT EXCHANGERS HAVING NON-EQUAL TUBE PASSES. El-Fouly, M. F.; El-Saiedi, A. F.; Darwish, M. A. (Atomic Energy Establishment, Cairo (Egypt). Reactors Dept.). 1972. 20p. Dep. NTIS (U. S. Sales Only).

Single shell, two tube-pass, parallel counter flow heat exchangers having non-equal tube passes were studied. Relations between the heat exchanger effectiveness, its number of transfer units, the hot and cold fluids heat capacity ratio, and the percentage of the first pass cross-sectional area to the total area of the heat exchanger were derived. Figures showing such relations are presented. (auth)

16511 (CEA-CONF-2071) SPECIAL ASPECTS OF SEALING PROBLEMS ENCOUNTERED IN NUCLEAR ENGINEERING. Elie, X.; Martin, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 16p. (In French). (CONF-720574-1). Dep. NTIS (U. S. Sales Only).

From Spring meeting of the Mechanical Engineering Development Group; Paris, France (16 May 1972).

The inadequacy of traditional techniques when used to effect seals in the fields of nuclear engineering is discussed. Difficulties arise from the action of radiations, the corrosiveness of certain fluids, and the high pressure and temperatures encountered. Various problems encountered in different types of reactor are discussed: behavior of elastomer joints during irradiation in heavy water moderated reactors and gas cooled reactors (EL-2); difficulties encountered in developing the primary circuits of graphite moderated power reactors; swelling of elastomer seals; problems involved in effecting sealed joints between the base of the vessel and the pressure tubes containing the fuel in heavy water moderated reactors cooled with CO_2 at 60 bars (EL-4); development of demountable welded joints; adopting of a system with two cooling circuits in series (primary and secondary) or integrated systems for fast Na cooled reactors; problems occurring with joints in high temperature reactors and cladding control problems in He reactors. Problems existing in isotopic U enrichment plants using the gas diffusion technique are discussed, together with difficulties met in heavy water production plants. (France)

16512 (CONF-701074-9) SINGLE-PASS STEAM GENERATOR WITH SODIUM COOLANT. Stekol'nikov, V. V.; Bagdasarov, Yu. E.; Titov, V. F.; Bogdanovich, P. N.; Kulikov, E. V.; Fedorov, L. F.; Poplavskii, V. M. Translated from pp 595-603 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. I. 8p. Dep. NTIS.

The design of a vessel-type sodium-cooled steam generator with a thermal capacity of about 500 MW for the production of high-pressure superheated steam is examined. The vessels of the evaporator and steam superheater are built separately, and the surfaces of the main and intermediate superheaters are combined in a single vessel. The heat exchange surface in both vessels is assembled in the form of flat plates made of coils of S-shaped form. (auth)

16513 (CONF-701074-11) MEASUREMENT OF THE CONCENTRATION OF FISSION FRAGMENTS IN THE PRIMARY LOOP BY THE DELAYED-NEUTRON METHOD. Moravek, J.; Gladky, E. Translated from pp 9-18 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. II. 9p. Dep. NTIS.

A method of measurement of delayed neutrons is described from the point of view of use for monitoring fission fragments in the primary circuit of a nuclear reactor with gas coolant. An algorithm is derived for calculation of the sensitivity of detection of fission fragments and the results of calculation of the dependence of sensitivity on the principal parameters of the reactor and detector are presented. On the basis of the calculation a theoretical optimization is made of the principal parameters of the detector and a design of the detector is proposed. An evaluation is given of the method from the point of view of the chemical state and behavior of radioactive iodine in the primary circuit and in the piping, its sampling and the possibilities of using it as a supplementary control for the system of monitoring the hermetic seal of the fuel elements. (auth)

16514 (CONF-701214, Paper No. 3) PROTECTION OF STEEL AND ALUMINUM AGAINST CORROSION BY WATER IN A NUCLEAR REACTOR. Zajic, Vladimir; Rypar, Vratislav (Inst. of Nuclear Research, Rez, Czech.). 6p. (In Czech).

From fifth conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The combined effects of corrosion in water and ionizing radiation on steel and aluminium alloys are reported. In view of the recent re-orientation of the Czechoslovak nuclear programme to light water reactors, the main trend is shown for materials employed in such reactors. (Nucl. Sci. Abstr. Czech.)

16515 (CONF-701214, Paper No. 23) DEVELOPMENT OF MATERIALS AND TECHNOLOGY FOR LIGHT WATER REACTOR PRESSURE VESSELS. Becka, Josef; Brumovsky, Milan; Indra, Jaroslav; Stepanek, Stanislav (Skoda Works, Plzen, Czech.). 17p. (In Czech).

From fifth conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The current status of pressure vessels for light water reactors in the world is reviewed. The differences in design, material, and technology between the American and the Soviet concepts are shown, and the preconditions are summed up for the manufacture of such vessels in Czechoslovakia. (Nucl. Sci. Abstr. Czech.)

16516 (CONF-701214, Paper No. 24) MAIN CIRCULATING PUMPS FOR PRESSURIZED-WATER REACTORS. Bedar, Josef (Pumping Equipment and Valves Manufacturing Works, Olomouc, Czech.). 23p. (In Czech).

From fifth conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A brief description is given of the development of main circulating pumps for pressurized-water reactors, and the parameters are discussed of canned motor pumps or wet stator pumps and of shaft-sealed pumps. Design studies of pumps are also described, worked out at the SIGMA works for pressurized-water reactors of the Voronezh type with capacities of 440 and 1000 MW(e). (Nucl. Sci. Abstr. Czech.)

16517 (CONF-721129-1) ELASTIC-PLASTIC-CREEP ANALYSIS OF CYLINDRICAL PRESSURE VESSELS SUBJECTED TO CYCLIC THERMAL LOADING. Minami, H. M. Jr.; Roberts, G. O. (Atomics International, Canoga Park, Calif.). [nd]. Contract AT(04-3)-700. 59p. Dep. NTIS.

From ASME Winter annual meeting; Washington, D. C. (28 Nov 1971).

The severe sodium thermal transients to which Liquid Metal Fast Breeder Reactor (LMFBR) components must be designed require a stress analysis which considers the inelastic behavior of the structure. An elastic-plastic-creep analysis is performed to determine the structural response of a cylindrical pressure vessel when subjected to a series of loading cycles of internal pressure, thermal shock, and extended high-temperature operation. The stress, strain, and displacement history of the vessel wall during several loading cycles are obtained by utilizing slightly modified versions of existing finite difference and finite element computer programs. It is demonstrated that the elastic-plastic-creep interaction analysis of one- and two-dimensional structures can be performed with existing techniques. Further, the methods allow the use of idealized descriptions of kinematic strain hardening, creep, and the annealing of strain hardening during extended high-temperature operation. The results of the analysis are used to establish design life based on consideration of fatigue damage, creep rutpure, and strain limits for two wall thicknesses. The use of a two-term linear damage relation and the evaluation of total accumulated strain are demonstrated. 8 references. (auth)

16518 (EUR-4902) FRANCESCA BWR: A NUMERICAL PROGRAMME FOR THE STEADY STATE AND DYNAMIC CALCULATION OF PARALLEL COOLANT CHANNELS FOR BWR NUCLEAR REACTORS. Forti, G. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Dec 1972. 36p. Dep. NTIS (U. S. Sales Only). EUR B.Fr. 50.-.

FRANCESCA BWR solves the steady state and transient problem of a number of parallel BWR coolant channels by the finite difference method. The two-phase flow model includes subcooled boiling and vapor recondensation in the subcooled region. The kinematic model is essentially that of Zuber and Findlay, and includes the average effect of local vapor drift, as well as that of velocity and concentration distributions. The heat transmission in a cylindrical fuel element and cladding is considered at each axial

level, with neglect of axial heat conduction. Heat transmission from cladding surface to coolant is governed by the Colburn correlation and the Jeans and Lottes correlation respectively in convective and boiling transmission. The subcooled boiling inception point is determined by an original method and vapor production in the subcooled region is evaluated essentially by Bowring's method. The power distribution is freely specified in input, as well as power evolution during time. The coolant flow redistribution among the different groups of channels is evaluated by the program both in steady state and transients. (auth)

16519 (LIB/TRANS-456) CONSIDERATIONS REGARDING THE USE OF NON-DESTRUCTIVE TESTING METHODS IN THE RECURRING TESTING PROGRAM OF REACTOR PRESSURE VESSELS. Trumpfheller, R. Translated by U. Engelbert from a German paper. 11p. (CONF-701144-2). Dep. NTIS (U. S. Sales Only).

From Conference on welding in nuclear technique; Frankfurt am Main, Germany (12 Nov 1970).

Recurring testing on reactor pressure vessels is generally useful only by application of nondestructive methods, preferably by remotely controlled ultrasonic procedures. The test sensitivity should be adjusted having regard to the technical realities of testing and to the type of possible defects. (auth)

16520 (LIB/TRANS-457) EXPERIENCES AND RESULTS OF NONDESTRUCTIVE TESTING OF WELDING SEAMS ON THICK WALLS OF REACTOR PRESSURE VESSELS. Pahnke, R. Translated by U. Engelbert from a German paper. 9p. (CONF-701144-3). Dep. NTIS (U. S. Sales Only).

From Conference on welding in nuclear technique; Frankfurt am Main, Germany (12 Nov 1970).

The discriminate selection of sound input direction and sound angles and independent testing with the aid of several probes enables all reflectors which exist in a welding seam to be found within human limitation. Size determination at wall thicknesses generally requires application of special probes. Testing of radiation transmission showed that about 60-70% of indications could also be recognized on radiographic film. Radiographic examination is a useful extension of ultrasonic testing if small excesses of specified ultrasonic data have been observed and where a positive decision regarding the type of defect needs to be made. (Australia)

16521 (ORNL-4821) THIRD ANNUAL PROGRESS REPORT ON STUDIES IN APPLIED SOLID MECHANICS (NUCLEAR SAFETY). (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 138p. Dep. NTIS.

Accomplishments during calendar year 1971 under ORNL nuclear-safety-related solid mechanics programs for developing structural design technology for piping components and pressure vessel nozzle attachments are summarized. Carefully coordinated experimental and theoretical studies are being conducted to develop improved design methods for assuring the structural integrity of nuclear reactor pressure vessels and piping systems. Experimental data on structural behavior are presented. (92 references) (auth)

16522 (ORNL-tr-2648) REPORTS ON THE RESEARCH PROJECT ON PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS SPONSORED BY THE FEDERAL MINISTRY OF EDUCATION AND SCIENCE. Bunke, N. Translated for Oak Ridge National Lab., Tenn. from German report. 39p. Dep. NTIS.

In 1969 the German Federal Ministry of Education and Science initiated a research and development program on prestressed concrete pressure vessels for water cooled and HTGR-type power reactors. Brief summaries of the status and results of specific projects in this program are presented. (HDR)

16523 SLIDE RING SEALS FOR NUCLEAR POWER PLANTS. Mayer, E. pp 212-24 of Axiale Gleitringdichtungen. Duesseldorf; VDI-Verl. (1970). (In German).

The design of slide ring seals for pumps in the primary and secondary coolant circuit of nuclear power plants, the selection of materials, and their radiation stability are discussed briefly. (GF)

16524 AIR-TIGHT CLOSING VALVES. Parodi, L.; Foggini, G. pp 281-304 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The design elements of a high-pressure electromagnetic valve for closing the flow of the primary fluid of nuclear reactors consist of a positioning device, a power device, and a drive device. These valve components are described. The operational characteristics of the air-tight closing valve developed for use in reactors are reported in detail. (J.S.R.)

16525 MASS TRANSPORT OF STAINLESS STEEL CORROSION PRODUCTS IN FLOWING LIQUID SODIUM. Claxton, K. T.; Collier, J. G. (Atomic Energy Research Establishment, Harwell, Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 63-75(Jan 1973).

The mass transport of corrosion products likely to be encountered in a fast reactor through exposure of stainless steel to flowing liquid sodium is being studied. A pumped sodium loop capable of flow rates of 1100 kg/h at a temperature of 600°C was commissioned. This rig incorporates an indirectly heated active cylindrical test section and cold trapping and filtering facilities. It was operated under conditions which simulate those obtaining in a single tube of the intermediate heat exchanger of PFR. The initial experiments investigated the transport and deposition characteristics of ^{59}Fe, ^{54}Mn, and ^{60}Co. The iron behavior is characterized by its appearance as a firmly adherent deposit on pipework immediately downstream of the test section. The effect of velocity, temperature gradients, geometry, etc., were examined. Physical methods of analysis including scanning electron microscopy, Auger spectroscopy, and ion beam analysis were used to study the deposits formed. The behavior of ^{54}Mn is characterized by its rapid and highly preferential migration to the diffusion cold trap, the coldest part of the circuit. Experiments with ^{60}Co have indicated that its transport is more limited than ^{59}Fe and that the deposit is less strongly attached, being easily dislodged through velocity changes in the circuit. (auth)

16526 INVESTIGATIONS CONCERNING THE PROBLEM OF LOCAL COOLING DISTURBANCES IN FUEL ELEMENTS OF SODIUM COOLED REACTORS. Gast, K.; Kirsch, D.; Schleisiek, K. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 4: No. 3, 14-18(1972). (In German).

A great part of the work on the safety of sodium cooled breeder reactors deals with the propagation of disturbances or damage which arise in single fuel elements to neighboring elements. The initial conditions for local boiling and the boiling process itself are discussed. (GF)

16527 PROBLEMS OF DESIGN AND SAFETY ASSESSMENT OF PRESTRESSED CONCRETE REACTOR PRESSURE VESSELS. Maurer, H. A. (Europaeische Gemeinschaften, Brussels). Brennst.-Waerme-Kraft; 24: No. 10, 368-72(Oct 1972). (In German).

After a description of the basic principles for the design of prestressed concrete reactor pressure vessels, the design data normally used in practice are discussed. The design structure of a prestressed concrete vessel leads to problems of safety assessment and operational supervision, which are illustrated by possible cases of trouble. (auth)

Fuel Systems and Components

Refer also to abstracts 15136 and 15159.

16528 (AAEC/E-225) FLOW OF SPHERES AND NEAR-SPHERES IN CYLINDRICAL VESSELS. PART III. TRANSIT SPECTRA FOR RECIRCULATED RANDOM PACKINGS. Gatt, F. C. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Mar 1972. 96p. Dep. NTIS (U. S. Sales Only).

An experimental and statistical investigation of the transit number spectra (a particular transport characteristic) of identical pebbles in recirculated random packings in a cylindrical vessel with a base and a single central (axial) outlet is presented. The packings form beds which flow downwards under the influence of gravity through an extractor in the vessel's base. The experimental variables studied are the base angle, the pebble seeding radius, the pebble size, shape and specific gravity, the packing height, the vessel base shape and the vertical position of the vessel's extractor. The purpose was partly to study these variables for their effect on the amount of recirculation required for a particular pebble to emerge from the vessel and partly to obtain statistics on individual beds. (auth)

16529 (ANL-7867) CALCULATIONAL APPROACH TO THE ESTIMATION OF FUEL AND FISSION-PRODUCT VAPOR PRESSURES AND OXIDATION STATES TO 6000°K. Gabelnick, S. D.; Chasanov, M. G. (Argonne National Lab., Ill.). Oct 1972. Contract W-31-109-eng-38. 106p. Dep. NTIS.

A computational algorithm has been constructed which predicts the vapor pressures and oxidation states of fast-breeder-reactor fuel and fission-product elements. These data are of importance in the areas of fuel-cladding interaction, possible fuel failure propagation, fuel-coolant interaction, and reactor disassembly calculations. The calculations, which consider a three-phase (condensed oxide, condensed non-oxide, and vapor) closed thermodynamic system, are based on the assumptions of ideal solution

theory and temperature uniformity. On the basis of available thermodynamic data and extrapolations to 6000°K, and the assumption of 100% retention of fission-product gases within the closed system, vapor pressures, oxygen-to-metal ratios of the fuel, and oxidation states of condensed fission products have been computed as a function of initial fuel composition, burnup, and fuel density. Results of these calculations indicate the noble gases to be the major contributors to the total pressure at temperatures below 4000°K. Above 5000°K, gaseous fuel species and fission-product oxides become the principal contributors to the vapor pressure. The total pressures are relatively insensitive to initial fuel composition [O/M and Pu/(U + Pu) ratios] and to the exactness of the calculated oxygen partial pressure even at the higher temperatures. 27 references. (auth)

16530 (CONF-701074–15) ESTIMATION OF THE WORKING CAPACITY OF FUEL JACKETS OF FAST REACTORS. Likhachev, Yu. I.; Proshkin, A. A.; Shcherbakova, Zh. N. Translated from pp 320-39 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5–10 October 1970, Vol. III. 17p. Dep. NTIS.

Methods of determining the stressed and strained states of the jacket of the hermetic cylinder of fuel elements of fast reactors are examined. It is assumed that the jacket is loaded with internal pressure of gaseous fission products which have come from the fuel into the compensation volume and the pressure from the swelling fuel directly in contact with the jacket. The use of the theory of strengthening and of the method of solving the problem in increments of the components permits examining the performance of the jacket for both a constant reactor power and in transient processes. Creep strains of the fuel and jacket and the possibility of the appearance of instantaneous strains are taken into consideration, during operation of the reactor at the rated load and in transient conditions. The solution permits considering the influence of irradiation on the long- and short-term mechanical properties of the material of the jacket and fuel, and the influence of azimuthal irregularity of the temperature distribution on the working capacity of the fuel jacket is evaluated. The solution permits considering the influence of irregular swelling of the material of the fuel and the material of the jacket. The working capacity of the fuel jacket is estimated with respect to both the long-term strength (on the basis of the hypothesis of the summation of damages) and the intensity of accumulated strain during the service life. The results are presented of calculations of the strength of the fuel element of a fast reactor with a jacket of austenitic steel and fuel tablets of sintered uranium dioxide. (auth)

16531 (CONF-721112–6) POTENTIAL FUEL FAILURE PROPAGATION DUE TO FISSION-GAS RELEASE IN LMFBR SUBASSEMBLIES. Van Erp, J. B.; Chawla, T. C.; Wilson, R. E. (Argonne National Lab., Ill.). 1972. 16p. Dep. NTIS.

From American Society of Mechanical Engineers winter meeting; New York, NY (26 Nov 1972).

The potential mechanisms for pin-to-pin failure propagation due to fission gas release in fuel subassemblies of liquid metal cooled fast breeder reactors as a consequence of random failure of one or more fuel pins are analyzed. Two distinctly different potential fuel failure propagation mechanisms associated with fission gas release are identified, viz., (a) temperature transients induced in the cladding of adjacent fuel pins, and (b) transitory mechanical loads on adjacent fuel pins. The former failure propagation mechanism, which is found to be linked with a number of different fission gas release modes, is studied. Out-of-pile experiments using both metallic and nonmetallic fluids are described and results are given regarding the various fission gas release modes. It is concluded that extensive and rapid pin-to-pin failure propagation in current-design LMFBR fuel subassemblies, due to thermal transients induced in the cladding of adjacent fuel pins by fission gas release from one or more randomly failed fuel pins, is unlikely. 24 references. (auth)

16532 (EUR–4875) FORCED CONVECTION BURNOUT AND HYDRODYNAMIC INSTABILITY EXPERIMENTS FOR WATER AT HIGH PRESSURE. PART VIII. ANALYSIS OF BURNOUT EXPERIMENTS ON 3 x 3 ROD BUNDLES WITH UNIFORM AND NON-UNIFORM HEAT GENERATION. di Capua, E.; Riccardi, R. (FIAT, Turin (Italy). Sezione Energia Nucleare. ANSALDO S.p.A., Genoa (Italy)). Nov 1972. 78p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 100,-.

An analysis of burnout tests in a 3×3 rod bundle is performed, including tests with uniform and non-uniform axial and transversal heat generation. The calculation method used is the introduction of local parameters calculated by an open channel thermohydraulic code in critical heat flux correlations chosen for their wide validity range. More than 240 experimental tests are analyzed; the results appear to be fully satisfactory, giving a maximum approximation of 25%. (auth)

16533 (GAMD–10134) EVALUATION OF GRAIN SHIELDING FACTORS FOR HTGR COATED FUEL PARTICLES. Waelti, P. (Gulf General Atomic, Inc., San Diego, Calif.). 19 May 1970. Contract AT(04-3)-167. 22p. Dep. NTIS.

The calculation of effective cross sections for materials with grain structure has been investigated. A method based on Sauer's formalism is outlined that is not restricted to loosely packed grains and to small ratios of scattering to total cross sections (as opposed to the treatment based upon isolated grains reported earlier by Dyos and Pomraning). The method is applicable for GAROL type resonance calculations (i.e., resonance treatments that are based on an explicit calculation of the detailed energy spectrum) as well as for reactor cell calculations at thermal energies. The grain shielding factor for ThC_2 fuel particles in a carbon moderator has been calculated as an energy dependent quantity for the 21.8 eV and 23.5 eV Th-resonances at 300°K. The results are compared with a GAROL reference calculation (set up for the grains) and with the method given by Dyos and Pomraning. The maximum error for the energy dependent shielding factors of the present method is 1.3% compared to 11.3% in the method of Dyos and Pomraning. 6 references. (auth)

16534 (HEDL-TME–72-146) INFRARED NDT OF ELECTRICAL FUEL PIN SIMULATORS USED IN LMFBR THERMAL HYDRAULIC TESTS. Green, D. R.; Collingham, R. E.; Fischer, L. H. (Hanford Engineering Development Lab., Richland, Wash.). Nov 1972. Contract AT(45-1)-2170. 24p. Dep. NTIS.

Electrical resistance heating is used to simulate nuclear heating in fuel pin simulators that are used in LMFBR (Liquid Metal Fast Breeder Reactor) thermal hydraulic sodium tests. Thermal uniformity is essential in these simulators to ensure that the data obtained with them are meaningful. Mechanical integrity of the units is also important for timely and economical completion of the thermal hydraulic tests. An infrared line scanner is used as part of a testing system that is routinely applied to assure the quality of LMFBR fuel pin simulators used at the Hanford Engineering Development Laboratory. Typical defects that can be detected by this system include: regions of abnormal density in the heater core-to-clad insulator; displacement of the heater core away from center; flaws or thinning in the heater core that would cause localized abnormal heat production; thinning and some other types of cladding flaws; and defects in the braze joint between the copper "cold ends" and the nichrome core. Thermal analyses, destructive analyses and improved performance of the simulators have shown that the infrared nondestructive test results are valid. 4 references. (auth)

16535 (ORNL-TM–3988) IRRADIATION PERFORMANCE IN HFIR EXPERIMENT HRB-2 OF HTGR FUEL STICKS BONDED WITH REFERENCE AND ADVANCED MATRIX MATERIALS. Coobs, J. H.; Scott, J. L.; Montgomery, B. H.; Robbins, J. M.; Pollock, C. B.; Conlin, J. A. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 40p. Dep. NTIS.

Fuel sticks prepared by intrusion bonding with the reference Fort St. Vrain matrix and with various other matrix filler materials were tested. This instrumented and swept experiment, HRB-2, was irradiated for 257 days (11 cycles) at temperatures of 1100 to 1300°C to test the integrity and behavior of the coated particles and fuel sticks at high burnup (12% FIMA in fertile ThC_2 and ThO_2 particles and 24% FIMA in mixed carbide particles) and the design maximum HTGR fast-neutron fluence of about 8×10^{21} neutrons/cm^2 (>0.18 MeV). The fission-gas release rates were steady at acceptable levels (R/B approx 10^{-5}). After irradiation, the 14 short (0.7-in.-long) fuel sticks were intact although six of them showed slight debonding at the edges. Both 2-in.-long fuel sticks broke into three segments, probably due to bowing of the graphite sleeve, but they were otherwise in good condition. Polished sections confirmed the good performance of the matrix structure and of the TRISO- and BISO-coated particles. Only two failed particles were detected, and these were BISO-coated resin-derived particles observed in a specimen that received maximum exposure. These failures were attributable to interactions with the shrinking matrix. Linear shrinkage of the six fuel sticks that contained TRISO-coated particles were 1.0 to 1.6%, or well within design limits, while shrinkage of the specimens that contained BISO-coated particles was much greater (3.0 to 4.5%), as expected. Results from this experiment demonstrate that HTGR fuel sticks bonded with reference and alternate matrix materials will survive to the maximum design exposure. (auth)

16536 (RDT-E–6-17-T(8-72)) CORE RESTRAINT MECHANISM FOR SODIUM COOLED REACTORS (FABRICATION ONLY). (Division of Reactor Development and Technology (AEC), Washington, D. C.). Oct 1972. 20p. RSO.

The requirements for the fabrication, quality assurance, packaging and delivery of the core restraint mechanism for use in a liquid metal cooled reactor are described. (auth)

16537 FUEL ELEMENT FOR A FAST NUCLEAR REACTOR. Blake, L. R. (to United Kingdom Atomic Energy Authority). German Patent 1,439,774. 20 Jan 1972. (In German).

The fuel element is characterized in that the metallic cylindrical casing containing the fuel is not completely filled with the fuel so as to leave an inner cavity for the fission products and to allow for fuel expansion. The cylindrical casing consists of an inner and outer cladding, with the outer cladding being designed so as to support the inner cladding in a specific elastic way. The clearance between the inner and outer cladding is filled with a material having a good thermal conductivity. (GF)

16538 APPROXIMATE ANALYSIS OF RAPID FISSION GAS RELEASE IN A SODIUM COOLED FAST REACTOR SUBASSEMBLY. Judd, A. M. (Cambridge Univ., Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 43-46(Jan 1973).

The maximum rate of release of fission gas from a failed fuel pin is calculated, allowing for the resistance to the gas flow offered by the axial breeder fuel in the pin. The effect on the subassembly coolant flow of gas released at this rate by simultaneous or near-simultaneous failure of many pins is then estimated approximately. It is concluded that if there are no axial holes through the breeder fuel, the gas release cannot cause bulk coolant boiling, and that if there are holes, boiling is very unlikely. (auth)

16539 FUEL PIN FAILURE PROPAGATION IN A SODIUM COOLED FAST REACTOR. Judd, A. M. (Cambridge Univ., Eng.). J. Brit. Nucl. Energy Soc.; 12: No. 1, 35-42(Jan 1973).

The consequences of random failure of one fuel pin, of a local coolant flow blockage, and of accidental over-enrichment of the fuel in one pin are analyzed in the light of currently available information to identify the routes which might lead to widespread damage. It is concluded that pin failure or coolant blockage probably cannot lead to extensive fuel melting or structural damage, although this is not quite certain because of gaps in the understanding of the phenomena involved. Over-enriched fuel might initiate a propagating failure, but this can be made extremely unlikely by care in manufacture. (auth)

16540 DOMESTIC PRODUCTION OF NUCLEAR FUEL FOR JPDR-II. Nishimura, K.; Yamamoto, T.; Nishikawa, K.; Kobayashi, Y. (First Atomic Power Industry Group, Tokyo). FAPIG (Tokyo); No. 65, 38-40(May 1972). (In Japanese).

The production of nuclear fuel assemblies for the JPDR-II in Furukawa is outlined. Two kinds of fuel rods with different enrichment were produced. The diameter and wall thickness of the cladding tubes were thinner than those made previously. The enrichment of the UO_2 pellets and moisture in the fuel rods were carefully controlled. The quality of the Zircaloy-2 cladding tubes and of the end-plugs welded to the tubes were carefully tested. Other parts of the fuel assemblies, such as tie-plates and spacers, were produced and tested. Rods and other parts were assembled in a 7×7 fuel assembly. (Japan)

Auxiliary Systems, Protection Systems, and Engineered Safeguards

16541 (CONF-701214, Paper No. 38) INSULATING AND PROTECTIVE MATERIALS IN NUCLEAR ENGINEERING. Rotrekl, Bedrich; Svoboda, Bohumil (Research Inst. for Synthetic Resins and Lacquers, Pardubice, Czech.). 6p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The main applications of plastics in the construction of nuclear power stations are reviewed. Protective paints and floorings designed for active parts of the stations are described. (Nucl. Sci. Abstr. Czech.)

16542 (COO-2224-1) GENERIC EMERGENCY COOLING POND ANALYSIS, EMERGENCY COOLING POND ANALYSIS AND THE THEORETICAL BASIS OF THE GEPA COMPUTATIONAL PROGRAM. Edinger, J. E.; Buchak, E. M.; Kaplan, E.; Socratous, G. (Pennsylvania Univ., Philadelphia, Towne School of Civil and Mechanical Engineering). Oct 1972. Contract AT(11-1)-2224. 156p. Dep. NTIS.

The design requirements for power reactor emergency ponds are analyzed. 17 references. (auth)

16543 (RISO-M-1541) REMI/HEAT COOL: A COMPUTER PROGRAMME FOR CALCULATION OF CORE HEAT UP WITH SPRAY COOLING. Andersen, J.; Abel-Larsen, H. (Danish Atomic Energy Commission, Risoe, Research Establishment). Oct 1972. 29p. Dep. NTIS (U. S. Sales Only).

REMI/HEAT COOL is a computer programme for calculation of core heat-up transients. The code determines the temperature transient of the fuel, and evaluates the influence of emergency core coolant, i.e., spray cooling. REMI/HEAT COOL is based on separate description of the steam and water phase in the primary system, and a detailed description of the radiative heat transfer between the fuel rods and the shroud. The latter does involve a determination of the absorption of thermal radiation in the two-phase flow. Furthermore the programme considers the decay heat, metal-water reaction, heat transfer due to conduction and convection, and the film flow on rods and shroud. (13 references) (auth)

16544 TECHNICAL SAFETY RECOMMENDATIONS OF THE VdTUEV FOR THE LAYOUT OF REACTOR PROTECTIVE SYSTEMS, SHEET 1-3, MAY 1972. Tech. Ueberwach.; 13: No. 7-8, 267-8(1972). (In German).

Three sets of safety recommendations of the West German VdTUEV related to the design and operation of reactor protection systems are presented. The first deals with the guarantee of the operability of the reactor protection system. The second discusses excitation of the reactor protection system. The third covers requirements for data acquisition in the reactor protection system. (GF)

16545 TECHNICAL SAFETY RECOMMENDATIONS OF THE VdTUEV FOR THE LAYOUT OF REACTOR PROTECTIVE SYSTEMS, SHEET 4, JUNE 1972. Tech. Ueberwach.; 13: No. 11, 350(1972). (In German).

Design principles for the wiring of cables and leads of reactor protective systems are presented. (GF)

Operation and Economics

16546 (CONF-701214, Paper No. 14) PROBLEMS OF COOPERATION BETWEEN NUCLEAR POWER STATIONS OF DIFFERENT TYPES WITHIN AN ELECTRIC POWER SYSTEM. Adamik, V.; Novak, S. (Power Research Inst., Jaslovske Bohunice, Czech.). 20p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Problems with the introduction of nuclear power stations into an electric power system and of the cooperation of different types of nuclear power stations, particularly in regard to the load factor, are described. An analysis is given of the fast reactors doubling time and of the factors which affect it: the in-pile and out-of-pile time of core fuel, the breeding ratio, the specific power in fuel, the overall thermal efficiency of the power station, and the specific fuel charge. (Nucl. Sci. Abstr. Czech.)

16547 (CONF-701214, Paper No. 34) NUCLEAR POWER ECONOMICS IN CZECHOSLOVAKIA. Havlicek, Rostislav (Energoprojekt, Prague). 9p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A brief description is given of the methods used in the economic assessment of various types of nuclear power stations under Czechoslovak conditions. The main criterion is represented by net profit attained over the lifetime of a power station, discounted to the year in which the power station is put into operation. Results of the calculation are tabulated, showing the profitability of power stations with reactors of the Voronezh, CANDU, and SGHWR type. (Nucl. Sci. Abstr. Czech.)

16548 PROBLEMS OF FUTURE ENERGY SUPPLY. Bohn, T. (Kernforschungsanlage, Juelich, Ger.). Brennst.-Waerme-Kraft; 24: No. 10, 378-84(Oct 1972). (In German).

Starting with estimations of future energy consumption, the associated problems are discussed. On the one hand, periods for the exhaustion of primary energy resources are estimated by comparing these resources with the accumulated energy consumption. On the other hand, the influence of energy generation on the environment is investigated. The effects of energy conversion in power stations on the energy balance of the earth and its effects on the environment due to pollution and radiation are considered. Finally, the influence of future fusion reactors on the environment is considered. (auth)

16549 SIGNIFICANCE OF SEFOR. Arterburn, J. O.; Hikido, K. Elec. Light Power (Boston); 51: No. 1, 40-2(Jan 1973).

The Southwest Experimental Fast Oxide Reactor (SEFOR) was designed, built, and operated primarily to demonstrate the physics and inherent reactor safety of a mixed-oxide-fueled, fast-spectrum reactor. However, there were also many valuable contributions from this work that can be applied to development of the LMFBR.

These included: demonstration of the feasibility of the new method of refueling; confirmation of design adequacy; development of information on possible design refinements; redesign requirements; verification of heat exchanger performance to meet specifications; equipment reliability data; identification of equipment requiring additional development; demonstration of LMFBR operation and maintenance feasibility; and clarification of safety considerations which affect licensing requirements. It is concluded that SEFOR made contributions of great value to the development of the LMFBR. (LCL)

16550 TOWARDS A 1,000-MWe LMFBR: THE INFLUENCE OF COMPONENT DEVELOPMENT, PROTOTYPES, AND CONSTRUCTION EXPERIENCE. Wolfe, Bertram; Gibson, A. S.; Murphy, P. M.; Sawle, D. R. (General Electric Co., Sunnyvale, CA). Nucl. News; 16: No. 1, 35-42(Jan 1973).

The development of a commercially competitive 1000 MW(e) LMFBR requires the development of lower cost but reliable components and the accumulation of sufficient plant design, construction, and operating experience to give good cost and plant operability data. Tabulated information is presented on LMFBR test facilities in the US and overseas. Reactor and plant characteristics of seven facilities are compared. Demonstration plants are discussed in terms of what these plants can and cannot demonstrate as to the economics, operating performance, and optimum design of large plants. It is concluded that although these demonstration facilities indicate the capabilities of large commercial LMFBR's, it will still be necessary to make a substantial additional investment in LMFBR development in order to confirm the low cost potential of the LMFBR. (LCL)

16551 LMFBR: KEYS TO INDUSTRIAL SUCCESS. Taylor, J. H.; Petrick, N. A. Nucl. News; 16: No. 1, 43-8(Jan 1973).

The utility industry will not buy LMFBR power plants unless these companies are convinced that the LMFBR is reliable, licensable, buildable with available construction materials and methods, and will produce energy at less cost than other available nuclear power plant types. Each of these aspects is discussed in detail. It is concluded that the proposed Westinghouse LMFBR demonstration plant meets the objectives of demonstrating that LMFBR's can produce power reliably and safely in a utility environment and that economically competitive commercial breeders can be constructed and licensed. (LCL)

Safety and Siting

16552 (AEC-tr-7396) FURTHER DEVELOPMENT OF THE TECHNOLOGY OF LIGHT WATER-COOLED REACTORS. PROJECT 2b. COOLING CONDITIONS OF THE REACTOR CORE IN THE CASE OF THE MAXIMUM CREDIBLE ACCIDENT DURING REFILLING BY THE SAFETY FEED SYSTEM. Final Report. Inv. Reactor 45b. (Siemens A.G., Erlangen (West Germany)). Translated by W. J. Grimes from a German report. 130p. Dep. NTIS.

Single pipe experiments were conducted for the experimental investigation of cooling processes during the refilling of the reactor core of a pressurized water reactor following the design basis accident. The experiments are part of the German emergency cooling program. The internal diameter of the experimental pipe corresponded to the hydraulic diameter of a subchannel of the reactor core. The heat capacity of the fuel rod was simulated with sintered ceramic cladding. The results indicate the following: (1) In the flooding experiments the temperature of the cladding tube ceases to rise when the cooling medium reaches the lower edge of the hot tube. (2) The time to the passing in the downward direction of the Leidenfrost temperature (quench time) decreases with rising pressures and increasing feed volumes. (3) Control experiments with respect to the quench time yielded good agreement with American bundle experiments (FLECHT). (4) During the cooling process pressure and density variations occur. (5) The reproducibility of the single-pipe experiments is good. (6) Spray experiments yielded a substantially lower cooling effect in comparison with flooding tests. Spray cooling results in a retardation of the rise in tube wall temperatures. No general collapse of temperatures in the experimental pipe was observed to maximum temperatures of 1,000°C. (auth)

16553 (AREAEE-147) FREE CONVECTION OVER FLAT PLATES FOR THE USE IN REACTOR HAZARD ANALYSIS. El-Saiedi, A. F.; Darwish, M. A. (Atomic Energy Establishment, Cairo (Egypt). Reactors Dept.). 1972. 58p. Dep. NTIS (U. S. Sales Only).

A theoretical study on free convection heat transfer over vertical flat plate fuel elements is presented. It primarily aims at finding solutions for expressing the velocity and temperature fields around such plates in two cases: (a) when the heat flow is steady and wall temperature is uniform, and (b) for steady heat flow and wall temperature increasing as a power function of the distance along the plate. Such solutions were obtained and methods of computation of such solutions are discussed. (auth)

16554 (CONF-701074-1) HYPOTHETICAL ACCIDENT AT AN ATOMIC ELECTRIC POWER PLANT EQUIPPED WITH A VESSEL REACTOR. Dement'ev, B. A.; Kuznetsov, V. D. Translated from pp 219-35 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. I. 13p. Dep. NTIS.

The results are presented of an investigation of the consequences of an accident connected with hypothetical rupture of the circulation loop at an atomic electric power plant. Analytical models are examined which permit obtaining unexpected information for subsequent analysis of the situation after the accident: change of pressure in the primary circuit and the reactor rooms, the temperature conditions of the fuel elements, and the character of destruction of the core in the course of time. Certain distinctive features of the course of such an accident are reviewed. In conclusion, certain results are cited which were obtained in an experimental investigation of accidents of a similar type conducted on a model, which confirm the applicability of the approaches used for analysis of the consequences of such accidents. The results of the work can be used in the evaluation of the consequences of a hypothetical accident in the primary circuit of an atomic electric power plant equipped with a water-moderated water-cooled power reactor. (auth)

16555 (CONF-701074-2) ANALYSIS OF ACCIDENTS IN THE PRIMARY CIRCUIT OF AN ATOMIC ELECTRIC POWER PLANT WITH WATER-MODERATED WATER-COOLED REACTORS DURING PIPE RUPTURES. Mal'tsev, B. K.; Khlestkin, D. A.; Rzheznikov, Yu. V.; Stavritskaya, L. V.; Kanishchev, V. P.; Indurskiy, M. S. Translated from pp 236-63 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. I. 20p. Dep. NTIS.

An analysis was made of accidents connected with pipe ruptures in the primary circuit of an atomic electric power plant with water-moderated water-cooled reactors. Data are presented which generalize experimental investigations to determine the critical hot-water flow rates. On the basis of a multiregional model of the primary circuit, equations of energy and mass conservation and an equation of state are given which permit determining the character of the change of the coolant parameters when a leak forms. An example is presented of the calculation of the change of pressure, flow rate and mass level in the equipment when there is a rupture of the main circulation pipeline of a vessel-type reactor. A comparison is made with data obtained in the United States. (auth)

16556 (CONF-701074-16) OPERATING RELIABILITY OF WELDED HIGH-PRESSURE VESSELS. Alekseenko, N. N.; Gorynin, I. V.; Efimov, A. V.; Razov, I. A. Translated from pp 576-601 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. III. 21p. Dep. NTIS.

Questions of the reliability of welded high-pressure vessels are examined. The basis of evaluation of the operating reliability of high-pressure vessels was the concept of the temperature viscosity reserve of a structure. Corresponding to that concept is the scheme of brittle strength proposed for structural designs and extended to reactor vessels through the additional consideration of factors of thermal aging and neutron irradiation. Additional experimental data are given for the brittle strength measured in tests on welded large samples of 15Cr2MoFA steel with pulsed induction of brittle cracks. Experimental data are presented on the influence of long thermal aging and neutron irradiation on change of the brittle tendency of the metal of welded seams of 15Cr2MoFA steel used to make the vessels of water-moderated water-cooled reactors of atomic power plants. The proposed method permits estimating the allowable neutron flux on the material of the reactor vessel and at the same time its operating reliability. (auth)

16557 (CONF-701214, Paper No. 22) LIGHT WATER REACTORS IN DENSELY POPULATED AREAS. Mueller, Viktor (Skoda Works, Plzen, Czech.). 10p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Safety measures are discussed which permit construction of nuclear power stations using light water reactors in densely populated areas. Attention is paid to both failure prevention and failure limitation. (Nucl. Sci. Abstr. Czech.)

16558 (STI/DOC-10/139) EARTHQUAKE GUIDELINES FOR REACTOR SITING. A Manual Prepared as the Result of a Panel

on Earthquake Guidelines for Selection of Reactor Sites held in Vienna, 22–26 June 1970. (International Atomic Energy Agency, Vienna (Austria)). 1972. 29p. (CONF-700675). IAEA $2.00.

16559 EXPERIMENTAL STUDY ON SEISMIC CHARACTERISTICS OF BOILING WATER REACTORS. Tomita, H. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan); Sasaki, Y.; Nogiwa, Y.; Inoue, A.; Sakuranaga, T. Toshiba Rebyu; 27: No. 8, 774-9 (Aug 1972). (In Japanese).

A series of experiments were conducted to confirm the seismic characteristics of boiling water reactors. Out of the experiments presented are those considered especially important in regard to the core structure: those regarding the vibration of the core and the insertion of control rods into a vibrating core. As to the core vibration, measurement was made, in a water vessel, on four practical-sized fuel assemblies, and an assembly of $\frac{1}{4}$-scale model fuel elements, with a result that proved the validity of the model used in seismic analysis. The test on insertion of practical-sized control rods, by the use of a rod-driving mechanism, into the model fuel assembly in the state of vibration has verified that perfect scram can be performed even if the fuel is bent as much as 40 mm or more in case of an earthquake. (auth)

16560 MAIN STEAM ISOLATION VALVE NEWLY DEVELOPED FOR AN ATOMIC POWER PLANT. Nagai, H. (Tokyo Shibaura Electric Co. Ltd., Kawasaki, Japan); Egashira, K. Toshiba Rebyu; 27: No. 9, 841-4(Sep 1972). (In Japanese).

The performance of 10 in. isolation valves for the main steam piping of the advanced thermal reactor Fugen was investigated. The valves, installed at the front and back portions of the main steam piping passing through the reactor containment vessel, close in case of any trouble, such as breakage on the piping, to prevent loss of coolants as well as leakage of radioactive substances. The results of tests of the leakage at the valve seats and the gland packing, stress distribution, pressure loss, reliability of function, and durability prove that the valve fully satisfies every requirement. (auth)

16561 NEW COMPUTING MODEL FOR THE SIMULATION OF THE TIME-DEPENDENT PRESSURE DISTRIBUTION IN SAFETY CONTAINMENTS OF WATER-COOLED NUCLEAR REACTORS AFTER A LOSS OF COOLANT ACCIDENT. Brosche, D. Munich; Technische Univ. (1971). 28p. (In German). Available from the Library of the Karlsruhe Univ., Germany. Thesis.

An explanation of objectives and types of reactor containment is followed by a description of a new computing model. The developing digital computer program ZOCO V permits the determination of time-dependent pressure responses on arbitrary points of the safety containment. The investigation is mainly directed to the short-term behavior (until the pressure of the safety containment equals the primary system), but also considers the subsequent longterm behavior. The computing model is also able to calculate the time-dependent pressure distribution in the containment of a complicated geometrical structure. (GF)

16562 BATTLE OF THE BREEDER. Kenward, M. New Sci.; 56: No. 825, 710(21 Dec 1972).

The nuclear power industry sees the breeder reactor as the ultimate in fission reactors. Both the USA and Soviet Union have recently announced significant advances in their breeder programs. The French and British programs are more advanced than the US breeder effort although not quite up to the Soviet level. Some details of the cost of the US breeder reactor are given and those facts which are known of the Soviet BN 350 are considered. Environmentalists in America who object to nuclear power in general are particularly worried about the extra hazards introduced by breeders. Objections have focussed on the safety hazards inherent in assembling such a large mass of very hot fuel and the problem of cooling it in the event of a failure. (UK)

16563 ESTIMATION OF THE RELEASE LIMIT OF RADIOACTIVE GAS FROM A BWR IN NORMAL OPERATION. Izawa, S.; Yoshida, Y.; Sasaki, Y. (Japan Atomic Energy Research Inst., Tokai). Hoken Butsuri; 7: No. 2, 85-91(Jun 1972). (In Japanese).

Studies were made to obtain the release limits of radioactive gas from a stack in normal operation of a BWR plant. These included observation of the behavior of radionuclides in the plant system and determination of significant nuclides, referring to the data gained by the operation of the JPDR, and also the evaluation of exposures at ground surface level around the plant site due to the released noble gas cloud. It was found that the gamma exposure from a fission noble-gas cloud is a determining factor for the release limit from a BWR plant. The release limit of fission noble gases (diffusion mixture) from the JPDR with a 55-meter high stack is calculated as 47 Ci/h for the dose limit of 0.04 rem per 3 months under meteorological stability and a yearly average wind-speed of 3.6 m/sec. (auth)

16564 NUCLEAR PLANT SAFETY. IEEE Tutorial Course. Ferber, R. R. (ed.). Course Text 72 CHO 635-3 PWR. New York; Institute of Electrical and Electronics Engineers, Inc. (1971). 129p. $10.00.

Material prepared for the Nuclear Plant Safety Tutorial Course held during the IEEE 1972 Winter Power Meeting is presented. Separate lectures are included on: nuclear power production and the earth's atmosphere; biological consequences of nuclear radiations from reactor plants and fuels; pressurized-water reactor plant safety; radiation safety aspects of the General Electric boiling water reactor; gas-cooled reactor plant safety; fast reactor plant safety; AEC role in safety and environmental effects of nuclear power plants; and potential future fusion reactor safety. (LCL)

Steam and Power Conversion Systems

16565 TEST SECTION OF A STEAM GENERATOR IN THE FRAMEWORK OF THE DEVELOPMENT OF THE HEAT EXCHANGERS OF A FAST SODIUM REACTOR. Casalini, P.; Valentini, P.; Avanzini, P. G.; Di Leo, S. pp 197-258 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The development program of sodium heat exchangers in Italy is examined. The heat exchangers with sodium circulation for the fast power reactors of the CNEN are described, and their characteristics are given. The 1-MW(t) coupled sodium–water loop CSA-1 is designed for the testing of models of sodium-heated steam generators. The installation, its instrumentation and control, and its safety precautions are described. The SDP-2, a 1-MW(t) test section for the study of a sodium steam generator with straight tubes, is also described. (JSR)

16566 TURBINES FOR POWER STATIONS WITH SATURATED STEAM. Vecchio, B. (Franco Tosi SpA, Legnano, Italy). pp 259-79 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The problems inherent to the design and construction of saturated steam turbines are reviewed. The operational characteristics of steam turbines for nuclear power plants are summarized. The effect of the volumetric capacity and the steam humidity on the design characteristics of the turbine is considered in some detail. The vapor separator and the intermediate resuperheating are discussed. (JSR)

16567 IMPORTANCE OF GAS TURBINES FOR ELECTRICITY SUPPLY NOW AND IN THE FUTURE. Hirschfelder, G. (Vereinigte Elektrizitaetswerke Westfalen AG, Dortmund, Ger.). Elektrizitaetswirtschaft; 71: No. 18, 509-12(1972). (In German).

As in the past, the gas turbine with open cycle will be important in power generation. Besides the increase in per-unit power of over 55 to 60 MW the growing supply of natural gas will also contribute as it makes possible the utilization of all the advantages offered by the gas turbine. It is probable that closed-cycle gas turbines will be used in the distant future in nuclear power stations with gas-cooled reactors. However the guidelines for future development still have to be laid down and comprehensive development will have to be done before they will actually be adopted. (GF)

16568 DRY COOLING FOR THERMAL POWER STATIONS. Wolf, H.; Steinbach, G. (Battelle-Institut eV, Frankfurt am Main). Elektrizitaetswirtschaft; 71: No. 3, 60-6(1972). (In German).

Dry cooling methods for waste heat from steam condensers of thermal power plants are surveyed. (GF)

16569 GAS TURBINES AND NUCLEAR POWER. Fortescue, Peter. Combustion; 44: No. 6, 17-20(Dec 1972).

The use of closed-cycle gas turbines with high-temperature gas-cooled reactors for electric power production is discussed in terms of the basic operating and thermodynamic characteristics of a closed-cycle gas turbine and the dry cooling tower requirements for a gas turbine plant as compared with a steam turbine plant. It is concluded that the closed-cycle gas turbine is advantageous for electric power production and that if the advantages of the closed cycle gas turbine, made possible by the advent of gas-cooled reactors and called for by impending shortages of plant sites with water supplies, are to be realized, a serious effort must be made now to develop gas turbines for the power industry. (LCL)

Commercial Power Reactors

Refer also to abstract 16294.

16570 (AECL-4265) CANADIAN POWER REACTOR PROGRAM: PRESENT AND FUTURE. Perryman, E. C. W. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 9p. (CONF-720659-1). Dep. NTIS (U. S. Sales Only). AECL $0.50.

From 27th annual congress of the Canadian Association of physicists; Edmonton, Alberta, Canada (27 Jun 1972).

A brief historical review of the Canadian Power Reactor Program is given, covering heavy-water moderated reactors cooled with heavy water, light water and organic liquid. The experience obtained from NPD and Douglas Point is discussed in relation to the first year's successful operation of the Pickering Nuclear Power Station. Future improvements and trends in the CANDU family of reactors are described. (auth)

16571 VIEW OF THE DUTCH ELECTRICAL ENERGY SUPPLIERS ON THE DEVELOPMENT OF THE NUCLEAR ENERGY IN THE NETHERLANDS. Elektrotechniek; 50: 834-7(12 Oct 1972). (In Dutch).

The view of the Dutch electrical energy suppliers on the development of the nuclear energy in the Netherlands is discussed during the hearing for the public session of the Committee of Nuclear Energy and Environmental Hygiene of the Second Chamber (Tweede Kamer) of the Parliament. (Netherlands)

16572 FITTINGS FOR NUCLEAR POWER PLANTS. Bruns, H. J. (Deutsche Babcock and Wilcox Dampfkessel-Werke AG, Oberhausen, Ger.). pp 256-8 of Jahrbuch der Dampferzeugungstechnik. Essen; Vulkan Verl. (1972). (In German).

A brief review is given on the requirements of fittings in the nuclear power plant. The intention is to use as far as possible conventional constructions and to adjust them to the specific requirements by additional construction elements, careful choice of materials, and additional tests. (GF)

16573 2300 MWe NUCLEAR POWER STATION WITH GAS-COOLED HIGH-TEMPERATURE REACTORS. Waage, J. U. (Gulf General Atomic Co., San Diego, CA); Schuetzenduebel, W. G.; Fischer, P. U.; Meyer, L. Brennst.-Waerme-Kraft; 24: No. 10, 363-8(Oct 1972). (In German).

The decision of Philadelphia Electric Company to build a twin nuclear power station comprising two gas-cooled high-temperature reactors of 1160 MW(e) each marks the entry of this reactor system on the commercial market. The characteristic features o the nuclear steam supply system, which is fully contained within a prestressed concrete reactor vessel for this type of reactor, are described. The arrangement of the overall plant, as well as its operational aspects, are discussed. (auth)

Physics and Core Engineering

16574 (CONF-701214, Paper No. 13) STATUS OF HEAVY WATER REACTORS IN THE WORLD. Paulicka, Ivan (Bohunice Atomic Power Station, Czech.). 13p. (In Slovak).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The development and current status of heavy water reactors in the world are described. (Nucl. Sci. Abstr. Czech.)

Control Elements, Systems, and Instrumentation

16575 COMPUTER SYSTEMS IN CEGB NUCLEAR POWER STATIONS. Welch, B. R. (Central Electricity Generating Board, London). Nucl. Eng. Int.; 18: No. 200, 25-30(Jan 1973).

A detailed technical account is given of the evolution of the uses of computer systems in the nuclear power stations of the Central Electricity Generating Board. The first computers were used for burst cartridge detection. The next step was an alarm analysis computer installed at the Oldbury station. The applications of computer systems now include logging, startup control, steady-running control as well. The experience gained already from operational on-line computer systems is related to future system design. (auth)

16576 COMPUTER CONTROL AT PICKERING. Mahood, T. B. (Atomic Energy of Canada Ltd., Ottawa). Nucl. Eng. Int.; 18: No. 200, 31-36(Jan 1973).

The successful implementation of the digital computer system was proved during the commissioning and operation of the first three units of the Pickering nuclear station. The basic approach for the Pickering system is discussed with emphasis on specialized hardware and software. The dual computer system designed to meet reliability requirements and providing complete redundancy is described. Also described are operating experience with the hardware system, power control, control of fuelling machines, alarm systems, and experiences during commissioning. (UK)

16577 TAKING THE COMPLEXITY OUT OF THE CONTROL COMPLEX. Rippon, S. E. Nucl. Eng. Int.; 18: No. 200, 36-39 (Jan 1973).

A new control system, Nuclenet 1000, is an advanced modular concept for the basic hardware of a BWR plant control system. Its aim is to provide the most efficient co-ordinated control room by simplifying the control and display complex without sacrificing reliability. The interface between the operator and the control complex is described. It consists of an operator control console, emergency core cooling benchboard, supervisor's monitoring control and a display control system. The functions of each are explained. (UK)

16578 HARTLEPOOL AND HEYSHAM ON-LINE DATA PROCESSING SYSTEMS. Hilton, D. (Ferranti Ltd., Oldham, Eng.); Welbourne, D. Nucl. Eng. Int.; 18: No. 200, 39-42(Jan 1973).

The AGR stations at Hartlepool and Heysham rely on on-line data processing systems to provide data displays, logs and extensive direct digital control. The following main features are considered: block switching of sections of equipment between the normal on-line highway and the standby highway, input scanning equipment for both analogue and contact inputs situated remote from the computer, self test facilities, redundancy features, and power supplies. The localization of the scanning equipment results in a substantial saving on cabling. It is concluded that the careful computer system design provides the required high availability of equipment and facilities. (UK)

16579 ADVANCED CONTROL AND AUTOMATION IN NUCLEAR POWER PLANTS. Lunde, J. E. (Institutt for Atomenergi, Halden, Norway). Nucl. Eng. Int.; 18: No. 200, 42-45(Jan 1973).

A review is given of the current trends in the development of automated systems for control and supervision of nuclear power stations. The incentives for applying direct digital plant control and an outline of the particular features of modern control methods is included. As a result of recent developments in computer technology, it is expected that there will be a drift towards a modular computer system approach for reasons of improved flexibility and reliability. Such modular systems now being developed at Halden are described and utilization of operators' consoles and color display units is discussed. (auth)

16580 MONITORING, IDENTIFICATION, AND CONTROL OF NUCLEAR POWER SYSTEMS WITH AN ON-LINE COMPUTER. Kemeny, L. G. (Univ. of New South Wales, Kensington, Australia). Aust. Comput. J.; 4: No. 4, 170-176(Nov 1972).

A description is given of the "SNEDAC" data acquisition system which will be used for statistical measurements on reactor systems, reactor diagnostic and control studies, and systems optimization. The design and operational characteristics of "SNEDAC" are discussed. The system consists essentially of a low-speed data logging section scanning twenty channels and outputting the information at a rate of seventy-five characters per second on a strip printer and a paper tape channel operating in parallel. The low-speed logger is synchronized and interfaced with the high-speed section which incorporates a mini-computer and a nine-channel incremental tape deck. This part of the system operates at 30,000 Hz and it is anticipated that this performance will be eventually improved with the addition of an FM recording system and very high speed analog-to-digital conversion equipment. The diagnostic and control functions of the system are facilitated by the provision of a separate, hard-wired, dynamic analysis section interfaced with the computer and containing a pseudo-random noise generator and a digital correlator. The execution of diagnostic and control functions is based on programmed control and logic instructions and time series analysis algorithms, in particular the utilization of correlation and spectral analysis. The software philosophy and the numerical algorithms utilized for on-line operation are described. (auth)

16581 RADIATION MONITORING SYSTEM FOR NUCLEAR POWER PLANTS. Lane, S. A.; Griesacker, C.; Hamburger, T. (Westinghouse Electric Corp., Baltimore). Genshiryoku Kogyo; 18: No. 8, 33-7(Aug 1972). (In Japanese).

The radiation monitoring system, RMS 1000, is used for radiation monitoring and radiation density detection within nuclear power plants. Radiation detection is performed by Geiger–Müller tubes or scintillation detectors. The negative pulse chains generated in the detectors are converted to 0 to 10 V signals, the amplitude of which is equal to the log count rate, in the computer/indicator circuits. Since the monitors use the building block system, they can respond to any power plant needs. Operation

is available in five modes, i.e., normal level pulse mode, range expanding vistable mode, high-level alarm mode, low-level alarm mode, and test measurement mode. All instruments for any channel drawer are the same size. Radioactive gas detectors were designed to measure the β and γ activity in radioactive gases. They include off-line and in-line types. (Japan)

16582 AUTOMATIC START-UP PROGRAM BY MEANS OF COMPUTERS IN BWR NUCLEAR POWER PLANTS. Takagi, H. (Tohoku Electric Power Co. Ltd., Sendai); Aoki, R.; Kawahara, H.; Ookawa, K. Karyoku Hatsuden; 23: No. 4, 395-404(Apr 1972). (In Japanese).

This program concerns the operation of Onagawa Nuclear Power Plant, and will make a normally equipped process computer in the nuclear power plant perform part of start-up operations. Automation is practiced in the latter two of the following start-up procedures: start-up of a reactor; start-up of a turbine; and power increase of the plant. Manual operation and confirmation of conditions by operators necessary in the start-up process are concentrated at the following points in the control sequence during the automatic start-up: start-up standby; start-up; acceleration; synchronizing stand-by; parallel run; load control changeover; power increase-i; and power increase-ii. The computer itself is similar to conventional computers in BWR nuclear power plants, but an operational control system and systems for the maintenance of some peripheral equipment were added. (Japan)

Containment Systems, Shielding, Waste Processing, and Radiation Protection

16583 (IRS-T-23, pp 43-76) EXPERIENCE AND EXPECTATION VALUES FOR THE DISCHARGE OF RADIOACTIVE SUBSTANCES FROM NUCLEAR POWER PLANTS. Schmitz, G.; Suetterlin, L. (Institut fuer Reaktorsicherheit, Cologne). Jul 1972. (In German).

From Institute for Reactor Safety technical meeting; Cologne, Germany (8 Nov 1971).

For standard types of nuclear power stations with pressurized water reactors and boiling water reactors, the paths of radioactivity from the location of production to the stack are described and the expected releases via these paths during normal operation are calculated. The release of activity by both a leakage of coolant and by a cleaning of the coolant are considered separately. Using certain assumptions it is determined that the release of activity via leakages of the coolant does not depend upon the power of the reactor, whereas the release of activity via cleaning of the coolant is directly proportional to the power of the reactor. The following standard values for the release of activity through the stack during normal operation are based upon technical specifications about the rate of transfer from the fuel to the coolant, and upon the leakages of the coolant as given by the manufacturer. Rare gases: 4,000 Ci/yr (PWR), 1,000 Ci/yr (BWR); ^{131}I: 0.5 Ci/yr (PWR), 0.7 Ci/yr (BWR). The rates of transfer from the fuel to the coolant are accepted as given by the manufacturer. However, values of coolant leakages as given by the manufacturer are tested by calculating the effective coolant leakages of the nuclear power stations KWO, KRB, and KWL. These calculations are based upon the measured release of activity from these power stations considering their specific differences in construction compared to those of the standard types. The values of the effective leakages differ from the values of the actual loss of the coolant by the factor in which the activity within the actual loss of coolant is reduced on its way from the location of leakage to the stack due to uncontrolled adsorption effects. It appears that the effective leakages given by the manufacturer are realistic when compared with our calculated leakages. Therefore, the above calculated release rates are valid. (GF)

16584 (IRS-T-23, pp 77-115) PROBLEMS OF THE CONCENTRATION OF NUCLEAR POWER PLANTS ON A NARROW SPACE: FUNDAMENTALS FOR EXPOSURE PLANS. Handge, P.; Schwarzer, W. (Institut fuer Reaktorsicherheit, Cologne). Jul 1972. (In German).

From Institute for Reactor Safety technical meeting; Cologne, Germany (8 Nov 1971).

The discharge of airborne radioactivity from nuclear plants and from other nuclear facilities gives cause to an increased radiological burden in the environment of these installations. A spatial concentration of nuclear power plants leads to a superposition of radiological doses originating from the individual sources. Maximum expected radiological doses are derived for simple spatial distributions of nuclear power plants. For the mean European weather it can be shown that: 1) a superposition of radiological doses in the environment of several sources can be neglected if each individual source complies with the valid limits for the radiological exposure of the environment of nuclear power plants and if their respective distances are larger than 30 km; 2) the release rates of the individual sources have to be considerably lower than the release rates admissible for a single isolated plant, if the distances between the sources become less than 20 km; 3) the expected release rates do not necessitate siting restrictions; 4) on a long term basis, the release of the entire amount of ^{85}Kr from the fuel reprocessing plants into the atmosphere cannot be tolerated. (GF)

16585 (IRS-T-23, pp 117-40) MEASURES FOR DISCHARGE LIMITS FROM THE INDUSTRIAL VIEWPOINT. Heitmann, H. G. (Kraftwerk Union AG, Erlangen, Ger.). Jul 1972. (In German).

From Institute for Reactor Safety technical meeting; Cologne, Germany (8 Nov 1971).

Concerning the release of radioactivity from nuclear power plants, only liquid or gaseous forms of radioactive materials are of environmental importance. Up to now, quantities of gaseous wastes produced from nuclear power plants with pressurized water reactors have been released from waste gas holding containers. Projected nuclear power plants and those under construction, however, will release these gaseous wastes through a charcoal delay system. The release of radioactive waste gases from nuclear power plants with boiling water reactors will also be through a charcoal delay system. With these delay systems, a detaining capacity of 40 to 60 d for xenon, and approximately 2.5 d for krypton is attained. These systems will also remove iodine aerosols. The dose that would occur by these processes is expected to be under 1% of the permitted ICRP values. The treatment of radioactive waste water involves methods of chemical precipitation, evaporation, deposition-filtration and ion exchange applied by both reactor types. With the aid of these auxiliary systems the released radioactivity is limited to the maximum permissible value of 5×10^{-4} Ci/m^3 before mixing with the main cooling water. When operating with accessory cooling devices, a further reduction of releasable radioactivity is possible along with a corresponding rise in technical expenditure. The processing systems for waste gas, air and water purification within pressurized and boiling water reactors are explained. Technical knowledge gained from previous operation experiences has led to further improvements of these purification systems in the current construction of power plants. Through these improvements, a further reduction of released radioactive gaseous and liquid wastes is achieved. For the nuclear power industry in Germany, specified values for the amount of radiation dose permitted in the vicinity of a nuclear power plant amounts to 30 mRem/y for gaseous and liquid wastes. An average increase, however, of approximately only 1 mRem/y is expected in the vicinity of a nuclear power plant in addition to the natural background radiation dose that varies between 100 and 150 mRem/y. (GF)

16586 RADIOACTIVITY AND RADIATION PROTECTION IN A LWR INSTALLATION. Eickelpasch, N. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.). At. Strom; 18: No. 9-10, 122-7(1972). (In German).

On the basis of the experience gained in the operation of the Gundremmingen nuclear power station for nearly six years, the type and magnitude of the radioactivity produced as well as the problems in radiation protection are discussed. Details are given of the effects of radioactivity on the installation when in operation, i.e., the dose rate on parts of the installation and in rooms, the aerosol activity transmitted to the outside. The difficulties in maintenance and supervisory work during the annual overhaul, which are due to radioactive pollution of the circulation channels, are dealt with. The effect on the dose rate of the repair personnel is discussed, and a few improvements are suggested. (GF)

16587 RADIOACTIVITY MONITOR FOR POWER PLANT ENVIRONMENTAL WATER. Reil, G. (Southern Nuclear Engineering, Inc., Bethesda, MD); Hawkins, W. M. Jr.; Liebler, G. H.; Duffey, D. Nucl. Technol.; 17: No. 3, 275-279(Mar 1973).

An automatic radioactivity monitor for gamma rays was operated continuously in the cooling water discharge canal of the Indian Point Power Reactor, Unit 1 for three months. The reliable performance, and particularly the observed sensitivity, indicated the feasibility of this system for automatically recording the radioactive content of environmental water. A similar system was later installed and is being operated routinely as a final check of the plant's radioactive waste system. The 5 in. diameter × 4 in. high NaI(Tl) underwater detector used was calibrated with 75 radioactive waste discharges (measured by other means) as standards. The counting efficiency was thereby determined to be 0.26 ± 0.09 counts/second/picocurie/liter. The computed lower limit of detection, for 95% confidence, 5% false alarm, with a 300 second integration and 10 CPS background was 3 picocurie/liter. (auth)

16588 CONCRETE PLACING FOR SHIELDING WALLS IN SHIMANE NUCLEAR POWER STATION. Hayashi, K. (Chugoku Electric Power Co. Inc., Hiroshima); Fujiki, Y. Konkurito Janaru; 10: No. 2, 23-32(Feb 1972). (In Japanese).

The Shimane nuclear power station is located in Kashima, Shimane prefecture, at a middle part of Shimane peninsula, and faces the Sea of Japan. Its land area is 120,000 m^2, and it employs a BWR of 460,000 kW(e) output. Commercial operation is expected in November 1973. The main buildings of the power station are the reactor building, turbine building, control building, and waste disposal building. A steel dry well containing a pressure vessel, circulating pumps and other equipment is placed in the reactor building, and surrounded with a ferroconcrete shielding wall 2.3 m thick. The shielding wall supports each floor and storage pools of spent fuel and a gas-water separator. It also serves as an aseismic structure. Problems in concrete pouring involved the specific gravity of the concrete and concrete thermal stresses at the time of pouring. The volume of concrete for the main building is about 79,000 m^3, and capacity of the concrete pouring equipment was 10,000 m^3/month using concrete pumps and large flexible vibrators. Shielding concrete was mixed so as to have good fluidity, a specific gravity of 2.2 or more, and small heat generation. The dominant factors affecting the specific gravity of raw concrete are the specific gravity of coarse aggregate and the amount of mixing air. For quality control of the shielding concrete, the accuracy of the weighing equipment and amount of water reducing agent were strictly controlled. The temperature rise due to curing heat was about 40°C. (Japan)

Cooling Systems

16589 (CONF-701214, Paper No. 20) PROPAGATION OF PRESSURE WAVES THROUGH THE PRIMARY CIRCUIT OF THE A-1 POWER PLANT. Kotrnoch, Josef; Mlady, Zdenek; Pecinka, Ladislav (Skoda Works, Plzen, Czech.). 19p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The propagation of pressure pulsations in the A-1 power plant was subjected to a qualitative analysis. The results indicated that the propagation of the energy pulses may be described as a sonic phenomenon. An equation was derived; it permits evaluation of the pulsation, the position of the wave nodes and other characteristics of the propagation as a function of the thermodynamic and transport properties of the medium and of the geometry of the ducts. The basis for the specific placement of measuring instruments and the principles used to evaluate the data are presented. A novel piezoelectric probe using a quartz crystal which can measure temperatures up to 150°C was developed for the experiments. (TTT)

16590 (CONF-701214, Paper No. 21) PARTICIPATION OF THE CZECHOSLOVAK INDUSTRY IN THE REALIZATION AND FURTHER DEVELOPMENT OF THE VVER POWER PLANTS. Filip, R.; Wagner, K. (Skoda Works, Plzen, Czech.). 3p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The immediate purpose of the construction of the first two 800MW(e) power plants is to increase rapidly the available power supply. For this reason, the native industry will participate only in the construction of the secondary circuit and of a few components of the primary circuit. It is suggested that in the future the construction program will make it necessary to master the problems involved in the control instrumention also. In addition, other portions and components of the primary circuit must be assigned to the native industry, taking into account the technical expertise of the Czechoslovak technology. (TTT)

16591 (CONF-701214, Paper No. 32) COOLING OF NUCLEAR POWER STATIONS. Sasek, Jiri (Energoprojekt, Prague). 12p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Cooling of nuclear power stations under Czechoslovak conditions is discussed. Owing to the fact that most Czechoslovak rivers have a low flow volume which varies throughout the year, cooling of nuclear power stations is now envisaged only with water circulating in cooling towers. However, future construction of nuclear power stations at river dams is not excluded. (Nucl. Sci. Abstr. Czech.)

16592 CONSTRUCTION OF PRESSURE VESSELS FOR HIGH POWER NUCLEAR REACTORS. Bragagnoli, F. (Breda Termomeccanica e Locomotive, SpA, Milan). pp 143-65 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

The construction of pressure vessels for the ENE1-IV, Brunsbuettel, and Philippsburgh power reactors is briefly outlined. The construction characteristics are given. The materials, fabrication techniques, and nondestructive testing are described. The mounting and hydraulic tests are briefly considered. (JSR)

16593 FAST CLOSING VALVE FOR USE IN WATER–STEAM. Agostini, V.; Premoli, A. (CISE, Milan). pp 305-24 of Giornate dell'Energia Nucleare 1970. Aspetti Meccanici e Costruttivi della Tecnica Nucleare. Rome; Comitato Nazionale Energia Nucleare (1972). (In Italian).

From Proceedings of 1970 nuclear energy conference; Milan, Italy (10 Dec 1970). See CONF-701231.

A quick-closing valve with teflon-faced mold was developed for use in the primary circuit of the CIRENE reactor. It has a closing time of less than 0.01 sec, operates in water–steam up to pressures of 70 kg/cm^2 at a temperature of 284°C, maintains a perfect seal after numerous openings, and has a limited loss of charge in the open-valve position. The operational principles of the valve are described. The general construction characteristics are given. The design criteria and operational conditions are discussed. (JSR)

16594 STEAM GENERATORS FOR THE SECOND DUTCH NUCLEAR POWER PLANT AT BORSSELE. Derksen, J. J. Ingenieur (Utrecht); 84: A960-1(3 Nov 1972). (In Dutch).

The design, construction, and planning of the steam generator for the Borssele Nuclear Power Plant in the Netherlands are described briefly. The steam generator is 16.4 m high, 4.2 m in dia., weighs 260 tons, and has a capacity of 1330 t/h 450 MW(e). The 4234 U-formed pipes are made of Incoloy-800. The total length is 24 km and the volume is 27.8 m^3. The steam generator was installed in the Spring of 1972. (Netherlands)

16595 HIGH INTEGRITY SODIUM STEAM RAISING UNIT. Linning, D. (United Kingdom Atomic Energy Authority, Risley, Eng.). Nucl. Eng. Int.; 18: No. 200, 46-48(Jan 1973).

A design is proposed for a sodium-heated steam-raising unit based on the proposition that the use of high-pressure water on the outside of the tubes and low-pressure sodium on the inside reduces the probability of failure, and also reduces the magnitude of the sodium/water reaction in the event of failure. Essential brazing methods are outlined and heat transfer characteristics, stress analysis, and tube reliability are discussed. It is claimed that the new approach does not involve either major new technological developments or additional capital investment. (UK)

16596 DISTRIBUTION OF ACTIVATION PRODUCTS IN THE COOLANT LOOP OF A BOILING-WATER REACTOR. Kramerov, A. Ya.; Chechetkin, Yu. V. This paper was summarized in At. Energ. (USSR); 31: No. 6, 619(Dec 1971) as paper No. 543/6314. (In Russian).

Full copy of this paper is held by TIC.

A procedure is described for calculating the distribution of activation products in the coolant loop of a BWR such as the VK-50. Equations describing two-phase flow as the flow of a homogeneous medium with effective local properties obtained by appropriate averaging are used. Satisfactory agreement between experimental data and calculations was obtained for ^{13}N, ^{16}N, and ^{18}F. (DLC)

16597 LEAKAGE TESTS OF MAIN STEAM ISOLATION VALVE FOR BWR. Amamiya, S.; Kato, H. (Hitachi Ltd., Ibaraki, Japan). Hitachi Hyoron; 54: No. 8, 1-5(Aug 1972). (In Japanese).

The main steam isolation valves for a BWR must prevent the reactor coolant from being released into the environs from the primary containment system if a main steam line breaks. Therefore, low leakage rate and positive performance are the most essential factors in the design of main steam isolation valves. Eight of these important valves, which were recently delivered to the Shimane Nuclear Power No. 1 Station, were subjected to various leakage tests and to 500-cycle performance tests at the Hitachi Works preceding their shipment to confirm their performance. The results of the tests, which were extremely satisfactory, are described. (auth)

Fuel Systems and Components

16598 (CONF-701214, Paper No. 9) SOME POTENTIAL IMPROVEMENTS OF THE FUEL ELEMENTS OF THE A-1 POWER PLANT. Krett, V.; Stepanek, K. (Skoda Works, Plzen, Czech.). 15p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Heat transfer calculations revealed that the diameter of uranium-containing core of the fuel elements may be increased; this would allow the use of fewer elements, thereby decreasing

the cost per kg of the elements. The new element assembly has a simple design consisting of a bundle of 55 uranium rods with a diameter ranging from 7.30 to 7.65 mm, clad with a 0.7-mm thick Mg–Be sheet. The rods are spaced on a 13.7-mm triangular lattice. Spiral ribs are used to ensure uniform spacing throughout the whole length of the hexagonal bundles. The hydrodynamic parameters of the system and the temperature distribution throughout the core were also determined. It is proposed to reuse the cladding from spent elements. (TTT)

16599 (GULF-GA-B-12344) DESIGN AND OPERATIONAL EVALUATION FOR FUEL TEST ELEMENTS NO. 14 AND 15. Scheffel, W. J. (Gulf General Atomic Co., San Diego, Calif.). 3 Nov 1972. Contract AT(04-3)-167. 34p. Dep. NTIS.

The design, composition, and operational performance—including the safety analysis—of fuel test elements No. 14 and 15 (FTE-14 and -15), which were inserted into the Peach Bottom reactor in the spring of 1972, are described. It is concluded that the operation of the reactor with FTE-14 and -15 will involve no hazard to the health and safety of either plant personnel or the public. It is also concluded that the existing and previously approved document for fuel test elements in the Peach Bottom reactor applies to FTE-14 and -15. 7 references. (auth)

16600 OPERATING EXPERIENCE WITH FUEL ELEMENTS. Eickelpasch, N. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.). pp 218-29 of Jahrbuch der Dampferzeugungstechnik. Essen; Vulkan Verl. (1972). (In German).

Following some general remarks on construction, requirements and costs of BWR fuel elements, a report on the operating of the fuel elements in the Gundremmingen reactor (KRB) are given. The methods of failure detection on fuel elements and the attained results are described by means of an actual example of fuel element defects in summer 1969. The activity release remained far below the tolerated maximum. The error quota of the fuel pins amounting to some parts per thousand is considered to be normal. (GF)

Auxiliary Systems, Protection Systems, and Engineered Safeguards

16601 POWER SUPPLY FOR NUCLEAR POWER STATIONS AND THE USAEC CRITERIA. Borst, A. (Kraftwerk Union AG, Erlangen, Ger.). Elektrizitaetswirtschaft; 71: No. 15, 450-2 (1972). (In German).

The new safety criteria and safety regulations of the USAEC specify different requirements for mains connection and mains supply to nuclear power stations. These criteria are compared with West German practices. The basic trend of the AEC criteria is due to a less redundant construction of an emergency diesel installation, and requires multiple feeds from the system. For FRG conditions the conclusion is drawn that effort and investment should be more in the direction of increasing the redundance and the independence to the emergency diesel installation, as well as the reliability of this standby function, rather than to use additional mains connections which are not clearly independent. (GF)

16602 SOLVING THAT DESPLITTERING HEADACHE. Nucl. Eng. Int.; 18: No. 200, 53-54(Jan 1973).

A desplittering machine is used to remove from Magnox fuel elements the splitter blade assembly, or cage, which is fixed to each finned can to improve coolant flow. At Bradwell an advanced and reliable machine capable of handling even badly deformed elements has given outstanding performance. The operation is briefly described. (UK)

16603 STARTING THE CONDENSATE CLEANING PLANT IN THE NUCLEAR POWER STATION AT WUERGASSEN. Gruenewald, Dieter (Kraftwerk Union AG, Frankfurt am Main); Kallenberg, K. Brennst.-Waerme-Kraft; 24: No. 10, 373-7 (Oct 1972). (In German).

After surveying the design lay-out, the various stages of starting the nuclear power station at Würgassen are described, as well as the purpose and effect of the condensate cleaning plant up to a power station output of 75%, corresponding to approximately 500 MW. The experiences gained from the starting operations are described. (auth)

16604 COOLING WATER PROBLEMS AT OLDBURY. Elec. Rev.; 191: No. 24, 815-16(15 Dec 1972).

Oldbury nuclear power station requires 20 million gal/hr cooling water drawn from the Severn estuary. An impounding reservoir was constructed in the estuary to ensure sufficient water at low tide. However, surveys showed a continuous build-up of silt and sand in front of the pumphouse. Radioactive tracer techniques were used to establish the behavior of the sand/silt. Efforts are now concentrated on a scheme for routine dredging to maintain a channel through the sandbank. (UK)

Operation and Economics

16605 (CONF-701074–4) BASIC OPERATING CHARACTERISTICS OF THE REACTOR INSTALLATION OF BLOCK II OF THE NOVOVORONEZHSKAYA ATOMIC ELECTRIC POWER PLANT. Ovchinnikov, F. Ya.; Voronin, L. M.; Samoylov, S. N.; Sedov, V. K.; Malkov, Yu. V.; Markov, Yu. V.; Dukhovenskii, A. S.; Belyaev, A. I. Translated from pp 335-49 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5–10 October 1970, Vol. I. 13p. Dep. NTIS.

Block II of the Novovoronezhskaya Atomic Electric Power Plant (AES), with a capacity of 365 MW, was included in the power system of the European part of the USSR at the end of December 1969. The main characteristics of Block II are described. An approach is presented toward the selection of the allowable operating conditions of the block, as well as the results of study of the characteristics of certain accidents and transient processes. Information is presented about the influence on the operating characteristics of the reactor of a solution of boric acid in the coolant of the primary circuit, used to regulate reactivity. (auth)

16606 (CONF-701074–13) PERIODIC INSPECTION OF THE STATE OF THE METAL OF EQUIPMENT OF UNITS I AND II OF THE NOVOVORONEZHSKAYA AES. Shabanov, N. N.; Mentsov, V. A. Translated from pp 116-30 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5–10 October 1970, Vol. II. 14p. Dep. NTIS.

As a result of analysing the operating experience of both foreign and Soviet atomic power plants and the inspection data for atomic power plants in operation and being put into operation, measures which will assure representative inspection of the state of the metal equipment and improve the operating reliability of the equipment are recommended. (auth)

16607 (CONF-701214) FIFTH CZECHOSLOVAKIAN CONFERENCE ON NUCLEAR POWER, PIESTANY, 1–2 DECEMBER 1970. (Ceskoslovenska Komise pro Atomovou Energii, Zbraslav nad Vltavon). 494p. (In Czech and Slovak).

Separate abstracts are included for 37 of the 38 papers presented on the development of power reactors and research reactors in Czechoslovakia. (DCC)

For abstracts of individual papers see: 16496, 16504, 16514–16516, 16541, 16546, 16547, 16557, 16574, 16589–16591, 16598, 16608–16614, 16653–16656, 16803, 16809–16815, 16832–16834, and 16844.

16608 (CONF-701214, Paper No. 7) ECONOMIC PROBLEMS OF FUEL SUPPLY TO LIGHT WATER REACTORS IN CZECHOSLOVAKIA. Vesley, Vladimir; Pesek, Vaclav (Inst. of Nuclear Fuels, Zbraslav nad Vltavou, Czech.). 18p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A preliminary assessment is given of fuel requirements set by the Czechoslovak nuclear programme based on Voronezh-type light water reactors. For a nuclear capacity of 9,000 to 16,000 MW(e) installed by 1990, the cumulative consumption of natural uranium was calculated to 16,000 to 25,000 tons. Plutonium production up to 1990 constitutes 8 to 11.5 tons of fissile isotopes, which, from 1988 on, will be sufficient for a 1000-MW(e) fast reactor. The costs are also indicated of individual items of fuel element production for light water reactors in Czechoslovakia. (Nucl. Sci. Abstr. Czech.)

16609 (CONF-701214, Paper No. 17) EBO R AND D WORK FOR THE CZECHOSLOVAK NUCLEAR PROGRAM. Hudec, Zdeno (Bohunice Atomic Power Station, Czech.). 10p. (In Slovak).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A brief description is given of the EBO R and D work serving the needs of the Czechoslovakia nuclear programme. Future projects are also outlined, particularly those related to the operation of the A-1 nuclear power station. (Nucl. Sci. Abstr. Czech.)

16610 (CONF-701214, Paper No. 18) ECONOMIC ASPECTS OF THE KS-TYPE REACTOR IN CZECHOSLOVAKIA. Cerny, Antonin (Bohunice Atomic Power Station, Czech.). 11p. (In Slovak).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The costs per kWh produced in the A-1 power station are analyzed in detail. Upon attaining the planned load factor and after reducing the fuel costs, the total costs per kWh produced will be about twice those in conventional power stations. In view of the purpose of the A-1 power station this is considered to be acceptable. (Nucl. Sci. Abstr. Czech.)

16611 (CONF-701214, Paper No. 19) EXPERIMENTAL APPLICATION OF THE A-1 POWER STATION. Spetko, Viliam (Bohunice Atomic Power Station, Czech.). 12p. (In Slovak).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The following components of the A-1 power station are considered to be suited for experimental applications: the primary circuit with steam generators and turbocompressors, the system of dosimetric control, the ventilation system, and the system for dosimetric measurements in the environment of the power station. A description is given of the problems which operation of the power station will solve, i.e., problems of materials research, physics and heat engineering of nuclear reactors, operating conditions of nuclear power stations, etc. (Nucl. Sci. Abstr. Czech.)

16612 (CONF-701214, Paper No. 27) RESEARCH ON FUEL CYCLES OF NUCLEAR POWER STATIONS CARRIED OUT IN THE CHEMISTRY DEPARTMENT OF THE INSTITUTE OF NUCLEAR RESEARCH. Havelka, Stanislav; Berak, Lubomir; Kourim, Vaclav; (and others) (Inst. of Nuclear Research, Rez, Czech.). 13p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The activities of the chemistry department of the Institute of Nuclear Research are reported. These include research on ceramic nuclear fuels, irradiated fuel processing (the PUREX process and the fluoride process), and treatment of waste from irradiated fuel processing. For each problem, a brief description is given of the current status and of the results obtained so far at the Institute. (Nucl. Sci. Abstr. Czech.)

16613 (CONF-701214, Paper No. 28) INFLUENCE OF NUCLEAR POWER STATIONS ON PRODUCTION COSTS OF ELECTRICITY IN THE ELECTRIC POWER SYSTEM UNDER CZECHOSLOVAK CONDITIONS UP TO 1985. Taller, Jan; Puschman, Jan (Inst. for Power and Energy, Prague). 19p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Three alternatives to the construction of nuclear power stations were considered with respective total capacities of 2300, 5000, and 6200 MW installed 1985. The total costs of the electric power system over the period of 1977 to 1985 in all the three alternatives range from 109.0 to 110.4 thousand million Czechoslovak crowns. The favorable effect of introducing nuclear power stations on reduced air pollution by flue ash and sulfur oxides is also shown. (Nucl. Sci. Abstr. Czech.)

16614 (CONF-701214, Paper No. 37) MODEL OF THE DEVELOPMENT OF NUCLEAR POWER GENERATION WITHIN THE LONG-RANGE OUTLOOK OF THE CZECHOSLOVAK ELECTRIC POWER SYSTEM. Flemming, Bohumil (Inst. for Power and Energy, Prague). 16p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Various economic alternatives for nuclear power generation were analyzed, considering "cheap" and "expensive" nuclear fuels and varying rates of return based on the compulsory inclusion of nuclear power plants in the network. It is suggested that electric power consumption will reach a saturation point at the 50,000 kWh/year per capita level during the 2030 to 2060 period. The calculation was based on the premise that the overall optimization costs will be discounted to the beginning of the program. The calculations indicate that if "cheap" fuel is indeed available, the program must be based at the start on light-water reactors, combining them later with fast breeders. (TTT)

16615 (DOCKET-50003-151) INDIAN POINT STATION, UNIT 1, No. 20 Control Rod Stuck. (Consolidated Edison Co. of New York, Inc., New York). 8 Jan 1973. 2p. Dep. NTIS.

16616 (DOCKET—50010-127) DRESDEN NUCLEAR POWER STATION, UNIT 1. Chimney Discharge Rate of Activity in Excess of 4.8×10^{-7} Curies/Sec. (Commonwealth Edison Co., Chicago, Ill.). 18 Jan 1973. 3p. Dep. NTIS.

16617 (DOCKET-50010-129) DRESDEN NUCLEAR POWER STATION, UNIT 1. Core Spray Valve CS-11 Failed to Open. Release of ^{131}I on January 9, 1973. (Commonwealth Edison Co., Chicago, Ill.). 25 Jan 1973. 3p. Dep. NTIS.

16618 (DOCKET—50029-222) YANKEE NUCLEAR POWER STATION. Operation Report No. 144 for Month of December 1972. (Yankee Atomic Electric Co., Westboro, Mass.). 25 Jan 1973. 10p. Dep. NTIS.

16619 (DOCKET—50133-107) HUMBOLDT BAY POWER PLANT, UNIT 3. Steps Taken to Comply With Regulatory Requirements. (Pacific Gas and Electric Co., San Francisco, Calif.). 26 Jan 1973. 6p. Dep. NTIS.

Information is presented concerning operating procedures, personnel training, and the use of additional lateral restraints for internal components. (DCC)

16620 (DOCKET—50155-137) BIG ROCK POINT NUCLEAR PLANT. Unexplained Radiation Monitor Alarm. (Consumers Power Co., Jackson, Mich.). 16 Jan 1973. 2p. Dep. NTIS.

16621 (DOCKET—50206-179) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Semiannual Report No. 10, January 1, 1972–June 30, 1972. (Southern California Edison Co., Rosemead, Calif.). 16 Jan 1973. 10p. Dep. NTIS.

16622 (DOCKET—50219-227) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Valve Malfunctions. (Jersey Central Power and Light Co., Morristown, N. J.). 17 Jan 1973. 10p. Dep. NTIS.

16623 (DOCKET-50219-231) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Quarterly Personnel Exposures, April 1, 1972–June 30, 1972. (Jersey Central Power and Light Co., Morristown, N. J.). 31 Jan 1973. 3p Dep. NTIS.

16624 (DOCKET—50220-120) NINE MILE POINT NUCLEAR STATION, UNIT 1. Turbine Trip of November 19, 1972. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 29 Dec 1972. 5p. Dep. NTIS.

16625 (DOCKET—50237-292) DRESDEN NUCLEAR POWER STATION, UNIT 2. 3/3 Diesel Generator Malfunction Incident Dated September 3, 1972. Switches for High Pressure Coolant Injection System Out of Calibration January 8, 1973. (Commonwealth Edison Co., Chicago, Ill.). 12 Jan 1973. 5p. Dep. NTIS.

16626 (DOCKET-50244-136) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Monthly Report of Activity Measurements, November 26, 1972—December 31, 1972. (Rochester Gas and Electric Corp., N. Y.). 17 Jan 1973. 2p. Dep. NTIS.

16627 (DOCKET-50249-183) DRESDEN NUCLEAR POWER STATION, UNIT 3. Switches of High Pressure Coolant Injection System Out of Calibration. (Commonwealth Edison Co., Chicago, Ill.). 17 Jan 1973. 2p. Dep. NTIS.

16628 (DOCKET-50249-186) DRESDEN NUCLEAR POWER STATION, UNIT 3. Containment Spray System 3/3 Core Height Interlock Sensor Outside Technical Specifications Limit. (Commonwealth Edison Co., Chicago, Ill.). 19 Jan 1973. 1p. Dep. NTIS.

16629 (DOCKET-50251-92) TURKEY POINT PLANT, UNIT 3. Reactor Coolant System RTD Bypass Loop Flow Transmitter Leaking January 6, 1973. (Florida Power and Light Co.). 15 Jan 1973. 2p. Dep. NTIS.

16630 (DOCKET-50254-160) QUAD-CITIES STATION, UNIT 1. Setpoint Drift of a Reactor Low Pressure Switch January 18, 1973. (Commonwealth Edison Co., Cordova, Ill.).. 25 Jan 1973. 4p. Dep. NTIS.

16631 (DOCKET-50261-137) H. B. ROBINSON UNIT 2. Refueling Operations. (Carolina Power and Light Co., Raleigh, N. C.). 23 Jan 1973. 10p. Dep. NTIS.

16632 (DOCKET-50263-174) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Excessive leakage past primary containment purge valve AO-2378. (Northern States Power Co., Minneapolis, Minn.). 18 Jan 1973. 1p. Dep. NTIS.

16633 (DOCKET-50263-176) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Low condenser vacuum scram switch diaphragm leak. Primary containment isolation valve leakage. (Northern States Power Co., Minneapolis, Minn.). 23 Jan 1973. 3p. Dep. NTIS.

16634 (DOCKET-50266-96) POINT BEACH NUCLEAR PLANT, UNIT 1. Steps taken to correct items of noncompliance brought to attention following inspection of September 12–14, 1972. (Wisconsin Electric Power Co., Milwaukee.; Wisconsin Michigan Power Co., Appleton, Wis.). 6 Oct 1972. 32p. (DOCKET-50301-81). Dep. NTIS.

Additional information is presented concerning the instrumentation testing schedule, incorrect flushing of the spent resin from the radioactive waste disposal system, and incorrect quality assurance procedures during construction of the radioactive waste disposal system. (DCC)

16635 (DOCKET-50271-136) VERMONT YANKEE NUCLEAR POWER STATION. Fan on Cooling Tower Failed January 15, 1973. Bearing Failure in Reduction Gear Unit of No. 1 Fan on

West Cooling Tower. A Loop Injection Valve Failed to Open January 15, 1973. Pressure Transient Resulted in Stack-gas Release of 2.5 Ci/sec January 16, 1973. Noble Gas Release Exceeded Limit of Technical Specification January 18, 1973. (Vermont Yankee Nuclear Power Corp., Rutland.) 15 Jan 1973. 6p. Dep. NTIS.

16636 (DOCKET-50295-80) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Failure of Diesel-Generator Unit. (Commonwealth Edison Co., Chicago, Ill.). 17 Jan 1973. 4p. Dep. NTIS.

16637 (DOCKET-50301-82) POINT BEACH NUCLEAR PLANT, UNIT 2. Violation of containment integrity. (Wisconsin Electric Power Co., Milwaukee.). 17 Jan 1973. 2p. Dep. NTIS.

16638 (DOCKET-50309-87) MAINE YANKEE ATOMIC POWER STATION. Operation Report No. 11-72, November 1972. (Maine Yankee Atomic Power Co., Westboro, Mass.). Jan 1973. 28p. Dep. NTIS.

16639 (DOCKET-50317-77) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Buckling of floor plates. (Baltimore Gas and Electric Co., Md.). 13 Dec 1972. 3p. (Docket-50318-74). Dep. NTIS.

Information is presented concerning the buckling of floor plates in the spent fuel pools. (DCC)

16640 (DOCKET-50317-79) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Action taken to correct the violations of AEC requirements brought to attention following inspections of September 26, 1972 and October 5-6, 1972. (Baltimore Gas and Electric Co., Md.). 24 Oct 1972. 23p. (Docket-50318-76). Dep. NTIS.

Additional information is presented concerning the containment structure repairs and the cleaner used on the stainless steel surfaces of the refueling water storage tank. (DCC)

16641 (DOCKET-50331-81) DUANE ARNOLD ENERGY CENTER. Operating Pressure and Temperature Limitations. (Iowa Electric Light and Power Co., Cedar Rapids). 22 Jan 1973. 2p. Dep. NTIS.

16642 (DOCKET-50331-82) DUANE ARNOLD ENERGY CENTER. Terrestrial Flora Study, August 1972 and Terrestrial Fauna Study, October 1972. (Iowa Electric Light and Power Co., Cedar Rapids). 19 Jan 1973. 149p. Dep. NTIS.

16643 (DOCKET-50341-47) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Ultrasonic Examination of Reactor Pressure Nozzle Forgings. (Detroit Edison Co., Mich.). 8 Dec 1972. 11p. Dep. NTIS.

16644 (IRS-T-23, pp 3-9) DEVELOPMENT FORECASTS OF NUCLEAR ENERGY. Schulten, R. (Kernforschungsanlage, Juelich, Ger.). Jul 1972. (In German).

From Institute for Reactor Safety technical meeting; Cologne, Germany (8 Nov 1971).

Computer programs have been developed in the last five years with the aim to achieve by means of technical and economic input-data a prognosis on which type of nuclear power plants is to apply in future. These computer models operate by economic optimization programs. The computer programs have shown in good correspondence the markets expected in future for uranium ore, for fuel element production and their reprocessing. Also, the results have clearly shown that the total capital demand for a change to nuclear engineering is high enough that a financial support by the Federal Republic can be justified. It is surprising, however, that the absolute heights of cost differ only a little from each other when considering different reactor types. Also the necessary uranium demand for the following 30 years is according to these estimates hardly influenced by the choice of certain reactor types. It is pointed out that cost estimates for the realization of future nuclear engineering are not realistic for various reasons, mainly because of a cost increase. Cost increases caused by increased requirements to safety techniques and by steadily increasing wages during the construction of nuclear power plants are above all not taken into account in prognosis models. One might guess that just the increased safety requirements and the steadily increasing demands concerning environmental protection will in future be a decisive criterion for the choice of a certain reactor type. (auth)

16645 (JPRS-56318) PLANNING AND OPERATION OF ATOMIC ELECTRIC POWER STATIONS. Translation of articles from Teploenergetika; No. 3, 2-10; 88-92(1972). 38p. NTIS.

For abstracts of individual papers see: 16489 and 16740-16742.

16646 (WASH-1198(1971)) REPORT ON RELEASES OF RADIOACTIVITY IN EFFLUENTS FROM NUCLEAR POWER PLANTS FOR 1971. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 1971. 12p. Dep. NTIS.

A tabulation of radioactivity released in effluents from U. S. nuclear power plants during January to December 1971 is presented. (auth)

16647 (WCAP-3385-32) SAXTON PLUTONIUM PROJECT. Quarterly Progress Report for the Period Ending June 30, 1972. Caye, T. E. (Westinghouse Electric Corp., Pittsburgh, Pa. Nuclear Fuel Div.). Nov 1972. Contract AT(11-1)-3044. 14p. Dep. NTIS.

The reactor operated at reduced steady state powers through May 1, 1972, when the Core III end-of-life shutdown occurred. The cumulative energy generated during Core III life was 5819 megawatt days, with a total of 631 load cycles. The peak burnups in the loose lattice regions were: for peak power rod, 29,100 MWD/MTM; and for highest burnup rod, 51,000 MWD/MTM. The reactor head was removed and the core was unloaded in preparation for shipment off-site. End-of-life sampling plans were prepared and submitted for internal review. (auth)

16648 AVAILABILITY STATE OF OPERATING NUCLEAR POWER PLANTS. Ettemeyer, R. (Kernkraftwerk RWE-Bayernwerk GmbH, Gundremmingen, Ger.). Energ. Tech.; 24: No. 9, 271-4(1972). (In German).

Four power plant types, GCR, BWR, PWR, and D_2O-moderated reactors, totalling 52 nuclear power plants were investigated with respect to their operating availability. Only such reactors of the Western world were considered which have a nominal power in excess of 20 MW(e) (an exemption is the VAK) and which have been in commercial operation for at least one year by the end of 1971. It was shown that the availability increases in the first 5 operating years. An operating availability of above 80% has been obtained in about a third of all considered operating years. The causes of the non-availability were investigated. (GF)

16649 OPERATING RESULTS OF THE THREE DEMONSTRATION PLANTS GUNDREMMINGEN (KRB), OBRIGHEIM (KWO), AND LINGEN (KWL). Weckesser, A. (Kernkraftwerk RWE-Bayernwerk GmbH, Gendremmingen, Ger.). pp 205-18 of Jahrbuch der Dampferzeugungstechnik. Essen; Vulkan Verl. (1972). (In German).

A review is given on availability, power output, and operating behavior of the individual plants during the years 1968, 1969, 1970, and 1971. Moreover, experience is reported concerning the following items: fuel elements, heat exchangers, turbines, personnel (for operation and repair), activity distribution, and release. (GF)

16650 OPERATION OF NUCLEAR POWER STATIONS AND EXPERIENCE IN RADIATION CONTROL. Itoh, T. (Kansai Electric Power Co. Inc., Osaka). At. Jap.; 16: No. 5, Suppl., 54-8(May 1972).

Nuclear power stations at Tsuruga, Fukushima, and Mihama have performed very satisfactorily since coming into commercial operation, and have yielded designed results. During the commercial operation period up to December 31, 1971, these nuclear power plants have been operated at a rate of between 60 and 70%, taking repair and maintenance suspension periods into account. This success in Japan is remarkable compared with other countries. It is necessary to carry out periodic inspection in coincidence with fuel replacement work. As for the turbine system, no serious problem has been reported. Control of radiation exposure should be undertaken in general on two levels: in the off-site environment and within the premises of nuclear plants. Environmental control at the nuclear power plants has been maintained with strict measures taken to check on the emission of gaseous and liquid effluents into the environment. Dozens of selected points in the plant area have been examined regularly to determine space dose rate, and results have shown that no particular change has been observed in findings since before the reactor reached criticality. (Japan)

16651 IS NUCLEAR TRAINING ON A STRAIGHT TRACK. Owens, Ken. Elec. Light Power (Boston); 51: No. 1, 25-7(Jan 1973).

Manpower requirements and programs for training manpower for operating nuclear power plants are discussed. Experiences of utility companies in selecting and training personnel are described and compared. Recommendations are made regarding the training and retraining of personnel for special operating conditions such as power level changes, startups, and emergencies. (LCL)

16652 EDUCATION FOR NUCLEAR PLANT JOBS. Elec. Light Power (Boston); 51: No. 1, 28-30(Jan 1973).

The manpower requirements for operating future commercial nuclear power plants are discussed. USAEC attitudes on methods for stimulating interest in these jobs and on educational programs for training nuclear power plant operating personnel are described. (LCL)

Safety and Siting

Refer also to abstract 15324.

16653 (CONF-701214, Paper No. 10) INSPECTIONS METHODS FOR THE PURPOSE OF THE IAEA SAFEGUARDS SYSTEM. Drahny, Milos; Svetlik, Jan (Power Research Inst., Prague). 19p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A description is given of an inspection method for the A-1 nuclear power station, representing a complex method for the safeguards system set up by IAEA. It consists of six principal phases: detection of fuel element movement outside the power station fuel cycle, fuel element identification, monitoring of fuel element movement on the prescribed route, determination of the amount of natural uranium in a new fuel element, determination of the thermal output of each fuel element during in-pile time, and determination of the amount of plutonium in each fuel element. An evaluation is also given of two methods of determining the reactor heat output: by measuring the electrical output of the generator, and by measuring the self-consumption of the power station. (Nucl. Sci. Abstr. Czech.)

16654 (CONF-7201214, Paper No. 15) SPECIFICATIONS FOR THE CONSTRUCTION OF THE VVER-1 POWER PLANT AT BOHUNICE. Smatlak, Stanislav (Bohunice Nuclear Power Plant, Czech.). 14p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The experience gained during the construction of the A-1 nuclear power plant is analyzed to determine the factors which contributed to the delays in placing the power plant in operation. On the basis of the conclusions, the anticipated schedule for the construction of the new, VVER-type power plant at Bohunice is presented. Management, labor relation and subcontracting problems involved in the construction are reviewed. (TTT)

16655 (CONF-701214, Paper No. 16) CONSTRUCTION AND STARTUP OF THE ATOMIC POWER PLANT. Kostovsky, Kristian (Bohunice Atomic Power Plant, Czech.). 11p. (In Slovak).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Some of the problems encountered during the final stages of the construction of the A-1 nuclear power plant are reviewed. The detailed program of the cold criticality tests, reactor physics studies and the three-stage power operation is outlined. The three-stage power operation is scheduled to last 300 days. Nuclear, radiation and conventional safety problems are analyzed. The program includes seven emergency shutdown operations at various power levels. (TTT)

16656 (CONF-701214, Paper No. 30) CONSTRUCTION OF NUCLEAR POWER STATIONS WITH VVER-400 TYPE REACTORS IN CZECHOSLOVAKIA. Hrdlicka, Jan; Holub, Jiri; Hanzlik, Jan (Energoprojekt, Prague). 12p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Jaslovské Bohunice in western Slovakia and Bukovany in southern Moravia were chosen as the construction sites of two nuclear power plants using Voronezh-type reactors (V-1, V-2). Justification of this choice is briefly outlined, and certain problems connected with the construction of these power stations are described. (Nucl. Sci. Abstr. Czech.)

16657 (DOCKET-50003-152) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change 48. (Consolidated Edison Co. of New York, Inc., New York). 9 Jan 1973. 8p. Dep. NTIS.

Revised technical specifications are presented concerning the use of respirators by personnel. (DCC)

16658 (DOCKET-50010-128) DRESDEN NUCLEAR POWER STATION, UNITS 1, 2, AND 3. Quad-Cities Station, Units 1 and 2. Zion Station Nuclear Power Plant, Units 1 and 2. Limitorque Valve Operators with Possible Defective Torque Switches. (Commonwealth Edison Co., Chicago, Ill.). 24 Jan 1973. 9p. (DOCKET-50237-291; DOCKET-50249-181; DOCKET-50254-158; DOCKET-50265-150; DOCKET-50295-82; DOCKET-50304-77.) Dep. NTIS.

16659 (DOCKET-50016-180) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Proposed Change. (Power Reactor Development Co., Detroit, Mich.). 24 Jan 1973. 1p. Dep. NTIS.

Revised technical specifications are presented concerning the subcritical requirements for a secured condition. (DCC)

16660 (DOCKET-50133-104) HUMBOLDT BAY POWER PLANT, UNIT 3. Little Salmon Fault System. (Pacific Gas and Electric Co., San Francisco, Calif.). 17 Jan 1973. 4p. Dep. NTIS.

16661 (DOCKET-50133-105) HUMBOLDT BAY POWER PLANT, UNIT 3. Off-gas System Designed Consistent With Safety Guides 26 and 29. (Pacific Gas and Electric Co., San Francisco, Calif.). 17 Jan 1973. 1p. Dep. NTIS.

16662 (DOCKET-50133-106) HUMBOLDT BAY POWER PLANT, UNIT 3. Technical Specification, Proposed Change No. 45. (Pacific Gas and Electric Co., San Francisco, Calif.). 25 Jan 1973. 3p. Dep. NTIS.

Revised technical specifications are presented concerning the hydrostatic pressure to be used in leak testing of the cooling system. The proposed change in pressure will be from 575 psig to 800 psig. (DCC)

16663 (DOCKET-50171-111) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Action Taken to Correct Items of Noncompliance Brought to Attention Following Inspection on October 31 and November 2–3, 1972. (Philadelphia Electric Co., PA). 22 Dec 1972. 22p. Dep. NTIS.

Information is presented concerning document control and written procedures for quality assurance requirements. (DCC)

16664 (DOCKET-50206-180) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Limitorque Valve Operator. (Southern California Edison Co., Rosemead, Calif.). 19 Jan 1973. 4p. Dep. NTIS.

16665 (DOCKET-50219-29) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Core Spray Suction Header Dynamic Analysis. (Jersey Central Power and Light Co., Morristown, N. J.). 16 Jan 1973. 2p. Dep. NTIS.

16666 (DOCKET-50219-228) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Fuel Densification Effects. (Jersey Central Power and Light Co., Morristown, N. J.). 18 Jan 1973. 5p. Dep. NTIS.

16667 (DOCKET-50219-230) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Facility Change Request No. 4. (Jersey Central Power and Light Co., Morristown, N. J.). 18 Jan 1973. 87p. Dep. NTIS.

Design characteristics and quality assurance requirements for Type 3B fuel bundles are presented. (DCC)

16668 (DOCKET-50220-121) NINE MILE POINT NUCLEAR STATION, UNIT 1. Temporary Alignment of 115 KV Transmission Lines. (Niagara Mohawk Power Corp., Lycoming, N.Y.). 26 Jan 1973. 3p. Dep. NTIS.

16669 (DOCKET-50237-293) DRESDEN NUCLEAR POWER STATION, UNITS 1 AND 2. Environmental Report, Supplement 4. (Commonwealth Edison Co., Chicago, Ill.). 15 Jan 1973. 54p. (DOCKET-50249-182). Dep. NTIS.

16670 (DOCKET-50237-294) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Torus Ring Header Analyses. Commonwealth Edison Co., Chicago, Ill.). 23 Jan 1973. 2p. (DOCKET-50249-184). Dep. NTIS.

16671 (DOCKET-50247-90) INDIAN POINT NUCLEAR GENERATING UNIT 2. Fuel Densification. (Consolidated Edison Co. of New York, Inc., New York). 18 Jan 1973. 88p. Dep. NTIS.

16672 (DOCKET-50250-111) TURKEY POINT PLANT, UNIT 3. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection October 19–20 and 25–27, 1972. (Florida Power and Light Co.). 29 Jan 1973. 8p. Dep. NTIS.

Information is presented concerning radiation protection procedures for personnel, site radiation monitoring requirements, and document control for current instrumentation set points. (DCC)

16673 (DOCKET-50250-112) TURKEY POINT PLANT, UNITS 3 AND 4. Final Safety Analysis Report, Supplement 55. (Florida Power and Light Co.). 19 Jan 1973. 16p. (DOCKET-50251-93). Dep. NTIS.

Revised and additional data are presented concerning the electrical system. (DCC)

16674 (DOCKET-50255-130) PALISADES PLANT. Additional Information on Loss-of-coolant Accident Calculations. (Consumers Power Co., Jackson, Mich.). 16 Jan 1973. 2p. Dep. NTIS.

16675 (DOCKET-50263-173) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Valve Wall Thicknesses Verification. (Northern States Power Co., Minneapolis, Minn.). 22 Jan 1973. 4p. Dep. NTIS.

16676 (DOCKET-50263-175) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Technical specification change request dated September 1, 1972, supplemental information. (Northern States Power Co., Minneapolis, Minn.). 18 Jan 1973. 1p. Dep. NTIS.

Additional information is presented concerning the rod drop accident analysis. (DCC)

16677 (DOCKET-50267-50) FORT ST. VRAIN NUCLEAR GENERATING STATION. Limitorque Valve Operators. (Public Service Co. of Colorado, Denver). 14 Dec 1972. 8p. Dep. NTIS.

16678 (DOCKET-50267-51) FORT ST. VRAIN NUCLEAR GENERATING STATION. Final environmental statement. (Directorate of Licensing (AEC), Washington, D. C.). Aug 1972. 279p. Dep. NTIS.

The environmental effects of construction and operation of the Fort St. Vrain Power Reactor Unit 1 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (DCC)

16679 (DOCKET-50269-86) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Simultaneous Actuation of a Safety Injection Signal on Both Units of a Dual Unit Facility. (Duke Power Co., Charlotte, N.C.). 2 Feb 1973. 6p. (Docket-50270-71; Docket-50287-63). Dep. NTIS.

16680 (DOCKET-50269-85) OCONEE NUCLEAR STATION, UNIT 1. Reactor Building Post-tensioning Initial Surveillance. (Duke Power Co., Charlotte, N. C.). 15 Jan 1973. 16p. Dep. NTIS.

16681 (DOCKET-50272-47) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Final Safety Analysis, Amendment 18. (Public Service Electric and Gas Co., Newark, N. J.). 15 Jan 1973. 251p. (DOCKET-50311-48). Dep. NTIS.

Revised and requested information is presented concerning the power conversion system, auxiliary systems, diesel generator, control system, operations, site, cooling system, and earthquake stress analysis for equipment and structures. (DCC)

16682 (DOCKET-50280-103) SURRY POWER STATION, UNITS 1 AND 2. Technical Specifications. (Virginia Electric and Power Co., Richmond). 29 Jan 1973. 299p. (Docket-50281-83). Dep. NTIS.

16683 (DOCKET-50281-84) SURRY POWER STATION, UNIT 2. Facility Operating License DPR-37. (Virginia Electric and Power Co., Richmond). 20 Jan 1973. 9p. Dep. NTIS.

16684 (DOCKET-50282-88) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 and 2. Order Extending Completion to February 1, 1974. (Directorate of Licensing (AEC), Washingt on, D. C.). 24 Jan 1973. 4p. (DOCKET-50306-84). Dep. NTIS.

16685 (DOCKET-50286-61) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final facility description and safety analysis report, Supplement 10. (Consolidated Edison Co. of New York, Inc., New York.). 19 Jan 1973. 402p. Dep. NTIS.

Revised and requested data are presented concerning the reactor site, engineered safeguards, cooling system, containment structure, instrumentation, auxiliary systems, radioactive waste disposal system, emergency plans, and safety analysis. (DCC)

16686 (DOCKET-50286-62) INDIAN POINT NUCLEAR GENERATING UNIT 3. Effect of Failure of Non-Category I (Seismic) Equipment of Performance of Safety Related Equipment. (Consolidated Edison Co. of New York, Inc., New York). 23 Jan 1973. 4p. Dep. NTIS.

16687 (DOCKET-50293-111) PILGRIM NUCLEAR POWER STATION. Fuel Densification Effects. (Boston Edison Co., Mass.). 4 Jan 1973. 2p. Dep. NTIS.

16688 (DOCKET-50295-77) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Steps taken to correct item of noncompliance brought to attention in letter of September 12, 1972. (Commonwealth Edison Co., Chicago, Ill.). 10 Oct 1972. 25p. (Docket-50304-74). Dep. NTIS.

Additional information is presented concerning the incorrect storage of main steam line isolation valves. (DCC)

16689 (DOCKET-50295-78) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Fuel Densification Effect. (Commonwealth Edison Co., Chicago, Ill.). 3 Jan 1973. 2p. (DOCKET-50304-75). Dep. NTIS.

16690 (DOCKET-50295-79) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Wall Thickness Verification for Certain Valves. (Commonwealth Edison Co., Chicago, Ill.). 8 Jan 1973. 5p. (Docket-50304-76). Dep. NTIS.

16691 (DOCKET-50295-81) ZION STATION NUCLEAR POWER PLANT, UNIT 1. Put Into Effect Program to Assure Valves Met Minimum Wall Thickness Requirements. (Commonwealth Edison Co., Chicago, Ill.). 22 Dec 1972. 1p. Dep. NTIS.

16692 (DOCKET-50295-83) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Consequences of Simultaneous Actuation Of A Safety Injection Signal. (Commonwealth Edison Co., Chicago, Ill.). 1 Dec 1972. 3p. (DOCKET-50304-78). Dep. NTIS.

16693 (DOCKET-50298-64) COOPER NUCLEAR STATION. Environmental Report, Supplement 6. (Nebraska Public Power District, Columbus). 5 Feb 1973. 30p. Dep. NTIS.

16694 (DOCKET-50298-65) COOPER NUCLEAR STATION. Limitorque Valve Operators. (Nebraska Public Power District, Columbus). 22 Jan 1973. 4p. Dep. NTIS.

16695 (DOCKET-50305-67) KEWAUNEE NUCLEAR POWER PLANT. Report KNR 3, environmental studies. (Wisconsin Univ., Milwaukee. Dept. of Botany.). May 1972. 134p. Dep. NTIS.

The preoperational environmental survey during January to December 1971 is presented. Data are included for temperature, radioactivity, sediments, phytoplankton, and zooplankton. (DCC)

16696 (DOCKET-50305-68) KEWAUNEE NUCLEAR POWER PLANT. Preoperational Thermal Monitoring Program of Lake Michigan January-December 1971. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). 14 Apr 1972. 180p. Dep. NTIS.

16697 (DOCKET-50305-69) KEWAUNEE NUCLEAR POWER PLANT. Limitorque Valve Operators. (Wisconsin Public Service Corp., Green Bay). 2 Jan 1973. 2p. Dep. NTIS.

16698 (DOCKET-50305-70) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 23. (Wisconsin Public Service Corp., Green Bay.). 22 Jan 1973. 105p. Dep. NTIS.

Revised and requested data are presented concerning auxiliary systems, personnel, cooling system, and safety analysis. (DCC)

16699 (DOCKET-50305-71) KEWAUNEE NUCLEAR POWER PLANT. Final Safety Analysis Report, Amendment 24. (Wisconsin Public Service Corp., Green Bay). 24 Jan 1973. 65p. Dep. NTIS.

Revised and additional data are presented concerning the electrical systems and piping system failures. (DCC)

16700 (DOCKET-50305-66) KEWAUNEE NUCLEAR POWER PLANT. Preoperational Radiological Monitoring Program, First Quarterly Report, September-November 1971. (Industrial Bio-Test Labs., Inc., Northbrook, Ill.). 21 Apr 1972. 94p. Dep. NTIS.

16701 (DOCKET-50317-78) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Fuel Densification Effects. (Baltimore Gas and Electric Co., MD.). 4 Jan 1973. 5p. (DOCKET-50318-75). Dep. NTIS.

16702 (DOCKET-50321-65) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Plans for Preventing Flooding Safety Features. (Georgia Power Co., Atlanta). 9 Jan 1973. 2p. Dep. NTIS.

16703 (DOCKET-50321-66) EDWIN I. HATCH NUCLEAR PLANT, UNITS 1 AND 2. Fuel Densification Effect. (Georgi Power Co., Atlanta). 3 Jan 1973. 1p. (DOCKET-50366-36). Dep. NTIS.

16704 (DOCKET-50321-67) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final safety analysis report, Amendment 27. (Georgia Power Co., Atlanta.). 15 Jan 1973. 138p. Dep. NTIS.
Revised and requested data are presented concerning physics calculations and reactor safety analysis. (DCC)

16705 (DOCKET-50324-36) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Design Reports Nos. 12 and 13. (Carolina Power and Light Co., Raleigh, N. C.). 29 Mar 1972. 102p. (DOCKET-50325-37). Dep. NTIS.

Information is presented concerning the engineered safeguards and turbine missiles. (DCC)

16706 (DOCKET-50324-65) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Environmental report, Amendment 5. (Carolina Power and Light Co., Raleigh, N. C.). 3 Jan 1973. 38p. (Docket-50325-66). Dep. NTIS.
Additional information is presented concerning radioactive effluents from the reactors. (DCC)

16707 (DOCKET-50327-30) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 12. (Tennessee Valley Authority, Chattanooga.). 15 Jan 1973. 14p. (Docket-50328-30). Dep. NTIS.
Additional information is presented concerning the containment structure divider barrier penetrations. (DCC)

16708 (DOCKET-50331-76) DUANE ARNOLD ENERGY CENTER. Steps taken to correct violation brought to attention following inspections on October 18-20, 1972 and October 26, 1972. (Iowa Electric Light and Power Co., Cedar Rapids.). 8 Jan 1973. 28p. Dep. NTIS.
Additional information is presented concerning quality assurance requirements for the control of materials used in welds. (DCC)

16709 (DOCKET-50331-77) DUANE ARNOLD ENERGY CENTER. Limitorque Valve Operators. (Iowa Electric Light and Power Co., Cedar Rapids.). 3 Jan 1973. 1p. Dep. NTIS.

16710 (DOCKET-50331-78) DUANE ARNOLD ENERGY CENTER. Administrative Procedures for Preoperational Testing. (Iowa Electric Light and Power Co., Cedar Rapids.). 4 Jan 1973. 19p. Dep. NTIS.

16711 (DOCKET-50334-50) BEAVER VALLEY POWER STATION, UNITS 1 AND 2. Fuel Densification Effect. (Duquesne Light Co., Pittsburgh, Pa.). 2 Jan 1973. 2p. (DOCKET-50412-4). Dep. NTIS.

16712 (DOCKET-50334-51) BEAVER VALLEY POWER STATION, UNIT 1. Action taken to correct items of noncompliance brought to attention following inspection on October 11, 12 and 13, 1972. (Duquesne Light Co., Pittsburgh, Pa.). 13 Nov 1972. 16p. Dep. NTIS.
Additional information is presented concerning the quality assurance requirements for welds and maintenance protection requirements for machined bearing surfaces of the neutron shield tank reactor support bases. (DCC)

16713 (DOCKET-50335-40) ST. LUCIE PLANT, UNIT 1. Fuel Densification Effects. (Florida Power and Light Co.). 4 Jan 1973. 5p. Dep. NTIS.

16714 (DOCKET-50336-49) MILLSTONE POINT NUCLEAR POWER STATION, UNIT 2. Fuel Densification Effects. (Millstone Point Co., Hartford, Conn.). 3 Jan 1973. 6p. Dep. NTIS.

16715 (DOCKET-50338-55) NORTH ANNA POWER STATION, UNITS 1, 2, 3, AND 4. Steps Taken to Correct Item of Noncompliance Brought to Attention Following Inspection of October 11-12, 1972. (Virginia Electric and Power Co., Richmond). 24 Jan 1973. 7p. (DOCKET-50339-52; DOCKET-50404-36; DOCKET-50405-36). Dep. NTIS.
Information is presented concerning quality assurance requirements for the control of engineering drawings for the electrical system. (DCC)

16716 (DOCKET-50339-53) NORTH ANNA POWER STATION, UNIT 2. Steps Taken to Correct Item of Non-Compliance Brought to Attention by Inspection on November 8-10, 1972. (Virginia Electric and Power Co., Richmond). 15 Dec. 1972. 7p. Dep. NTIS.
Requested information is presented concerning a discrepancy in a quality assurance test report. (DCC)

16717 (DOCKET-50341-48) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Violation of 10 CFR Part 50, Appendix B, Criterion V by Chicago Bridge and Iron Company. (Detroit Edison Co., Mich.). 27 Dec. 1972. 29p. Dep. NTIS.

Additional information is presented concerning the quality assurance requirements for monitoring the preheat temperatures for pressure vessel welds. (DCC)

16718 (DOCKET-50341-49) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Reactor Pressure Vessel Ultrasonic Indications. (Detroit Edison Co., Mich.). 17 Jan 1973. 49p. Dep. NTIS.

16719 (DOCKET-50341-50) ENRICO FERMI ATOMIC POWER PLANT, UNIT 2. Fuel Densification Effects. (Detroit Edison Co., Mich.). 3 Jan 1973. 1 p. Dep. NTIS.

16720 (DOCKET-50346-38) DAVIS-BESSE NUCLEAR POWER STATION. Steps taken to correct item of noncompliance brought to attention in letter dated August 31, 1972. (Toledo Edison Co., Ohio.). 5 Oct 1972. 6p. Dep. NTIS.
Additional information is presented concerning quality assurance requirements for materials and equipment procurement during construction. (DCC)

16721 (DOCKET-50348-49) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Fuel Densification Effects. (Alabama Power Co., Birmingham). 3 Jan 1973. 2p. (DOCKET-50364-41). Dep. NTIS.

16722 (DOCKET-50352-32) LIMERICK GENERATING STATION, UNITS 1 AND 2. Fuel Densification Effects. (Philadelphia Electric Co., Pa.). 5 Jan 1973. 1p. (DOCKET-50353-32) Dep. NTIS.

16723 (DOCKET-50354-35) NEWBOLD ISLAND NUCLEAR GENERATING STATION, UNITS 1 AND 2. Fuel Densification Effects. (Public Service Electric and Gas Co., Newark, N. J.). 3 Jan 1973. 1p. (Docket-50355-34). Dep. NTIS.

16724 (DOCKET-50358-44) WILLIAM H. ZIMMER NUCLEAR POWER STATION, UNIT 1. Ecological Baseline Studies. (Cincinnati Gas and Electric Co., Ohio). 24 Jan 1973. 27p. Dep. NTIS.

16725 (DOCKET-50368-37) ARKANSAS NUCLEAR ONE, UNIT 2. Fuel Densification Effects. (Arkansas Power and Light Co., Little Rock). 4 Jan 1973. 8p. Dep. NTIS.

16726 (DOCKET-50369-35) MCGUIRE NUCLEAR STATION, UNITS 1 AND 2. Department of Justice Agreeable to Issuance of a Construction Permit. (Department of Justice, Washington, D. C. Antitrust Div.). 11 Jan 1973. 2p. (Docket-50370-35). Dep. NTIS.

16727 (DOCKET-50395-37) VIRGIL C. SUMMER NUCLEAR STATION, UNIT 1. Safety Evaluation, Supplement 1. (Directorate of Licensing (AEC), Washington, D. C.). 12 Jan 1973. 57p. Dep. NTIS.

16728 (DOCKET-50398-28) MENDOCINO POWER PLANT, UNITS 1 AND 2. Environmental Report, Amendment to Supplement. (Pacific Gas and Electric Co., San Francisco, Calif.). 20 Dec 1972. 261p. (DOCKET-50399-28). Dep. NTIS.

16729 (DOCKET-50398-30) MENDOCINO POWER PLANT, UNITS 1 AND 2. Fuel Densification Effects. (Pacific Gas and Electric Co., San Francisco, Calif.). 3 Jan 1973. 2p. (DOCKET-50399-30). Dep. NTIS.

16730 (DOCKET-50398-32) MENDOCINO POWER PLANT, UNITS 1 AND 2. Notice of withdrawal of application for licenses. (Pacific Gas and Electric Co., San Francisco, Calif.). 30 Jan 1973. 3p. (Docket-50399-32). Dep. NTIS.

16731 (DOCKET-50410-19) NINE MILE POINT NUCLEAR STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 5. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 10 Jan 1973. 534p. Dep. NTIS.
Requested information is presented concerning the containment system, radioactive waste disposal, safety analysis, quality assurance program, and stress analysis for structures. (DCC)

16732 (ORNL-tr-2645) REPORT ON ASEISMIC DESIGN OF NUCLEAR POWER PLANTS IN THE FEDERAL REPUBLIC OF GERMANY. Huber, A.; (and others). Translation of German report. 67p. Dep. NTIS.
A state-of-the-art report is presented on the principles, methods, and information gaps in the seismic analysis and aseismic design of German nuclear power plants. (HDR)

16733 (TID-26201) INDEXES TO ECCS HEARINGS, NOVEMBER 14-DECEMBER 7, 1972. Stuber, C. E. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 15 Dec 1972. 75p. Dep. NTIS.

Public hearings in the matter of acceptance criteria for emergency core cooling systems for U. S. water-cooled power reactors are indexed. The index is in three parts: (1) subject index; (2) witness index; and (3) chronological index. (HDR)

16734 ORGANIZING AND CONSTRUCTIONAL ASPECTS AT THE CONSTRUCTION OF THE BORSSELE NUCLEAR POWER PLANT. I. ORGANIZATION OF THE PROJECT. Veld, J. in 't. (Bredero's Bouwbedrijf Nederland NV, Utrecht). Ingenieur (Utrecht); 84: A949-52(3 Nov 1972). (In Dutch).

A short survey is given of how the contract was obtained, based on a concise scope of work. Further, the necessary organization of the design group and the group for the site construction and construction of the nuclear and conventional buildings and the components for the cooling system is explained. The main materials quantities are mentioned. (auth)

16735 ORGANIZING AND CONSTRUCTIONAL ASPECTS AT THE CONSTRUCTION OF THE BORSSELE NUCLEAR POWER PLANT. II. DESIGN AND CONSTRUCTION OF THE BORSSELE NUCLEAR POWER PLANT. Petri, W. J. (Bredero's Bouwbedrijf Nederland NV, Utrecht). Ingenieur (Utrecht); 84: A952-60(3 Nov 1972). (In Dutch).

Problems concerning the design of the reinforced concrete structures of the reactor-building and their influence upon the construction are described. In this respect the foundation problems and form-work for the monolithic foundation-slab, outer-wall, and dome are discussed. The difficulties which will be encountered if a crack occurs in one of the big high-pressure pipelines are outlined. The foundation and pipeline-system for the cooling water are mentioned. (auth)

16736 SAFETY OF NUCLEAR POWER PLANT. Uchida, H. (Tokyo Univ.). At. Jap.; 16: No. 5, Suppl., 48-53(May 1972).

The goal of nuclear safety lies in the assurance that reactors will not have any substantial radioactive effect on the general public or on operating workers. A safety evaluation is necessary for the siting of any nuclear power plant. This safety evaluation is composed of safeguards for normal operation and evaluation against conceivable accidents. Consequences of the possible accidents can be evaluated as follows: first, possible radiation effects on the public are evaluated on the conservative assumptions of occurrence and results of all accidents; and, second, the incidence of postulated accidents and their radiation effect on the public are evaluated in terms of probability. The probability of postulated accidents is very small, but the probability of hypothetical accidents is much smaller. The safety of nuclear reactors must be assured by prepared countermeasures ready to cope with whatever outside trouble or transient disorder may occur. The worst accidents can be caused by damage of melt-down of fuel cladding. This accident is divided into two types; reactivity accidents and mechanical accidents. Each type of accident and its prevention are described. Loss-of-coolant accidents and engineered safety features are described, such as sprays, high-pressure core injection, and reactor containment systems. Normal operation should be ensured through research and study on the removal of very low-level radioactive wastes and their radiological effects, as well as studies of thermal pollution due to the release of condenser cooling water. (Japan)

16737 ACCIDENT ANALYSIS IN NUCLEAR TECHNOLOGY. Kellermann, O. (Technische Ueberwachungsvereine eV, Cologne). Tech. Ueberwach.; 13: No. 11, 330-5(1972). (In German).

A review is given summarizing the accident analysis for nuclear power plants starting with the safety concept of the maximum credible accident up to the risk concept on the failure expectancy (failure probabilities) of components and systems with reliability requirements. (GF)

16738 CONDITIONS OF LOCATION AND CIVIL CONSTRUCTION PLAN OF HAMAOKA NUCLEAR POWER STATION. Watanabe, I.; Tanaka, G. (Chubu Electric Power Co. Inc., Nagoya, Japan). Hatsuden Suiryoku; No. 115, 7-14(Nov 1971). (In Japanese).

The ground survey and construction work which preceded installation of Hamaoka Atomic Power-station, now under construction at a Pacific coastal area near Omae-zaki, Shizuoka Pref., are described with special reference to the physical geography and geological environment of the site. Information is included on the site topography, geology, oceanography, seismology, and hydrology, all of which are important in relation to the construction. The geologic survey and rock testing for the ground construction are briefly described. (Japan)

16739 DECISION OF THE FEDERAL COURT OF ADMINISTRATION REGARDING THE LICENSING PROCEDURE ACCORDING TO THE ATOMIC ENERGY LAW AND THE PROCEDURE IN CONTENTIOUS ADMINISTRATIVE MATTERS. Energiewirtsch. Tagesfragen; 22: No. 6, 315-20(1972). (In German).

In the procedure in the contentious administrative matter initiated by an action for annulment of the granting of partial licences for the construction of the Wuergassen nuclear power plant, the Federal Court of Administration on March 16, 1972 reversed the partial verdict against the plaintiff given by the Federal court of Muenster on February 17, 1972 in so far as this verdict dismissed the appeal, thus referring this matter back to the Federal court for retrial. The appeal of the appellant has been dismissed. The main grounds on which the judgment is based are presented. (GF)

Steam and Power Conversion Systems

16740 (JPRS-56318, pp 1-9) STEAM PARAMETERS FOR ATOMIC ELECTRIC STATIONS WITH WATER COOLED REACTORS. Kunegin, E. P.; Kramerov, A. Ya. Translated from Teploenergetika; No. 3, 2-4(1972).

Steam and feedwater conditions are discussed in regard to the turbines and steam generators of both boiling and pressurized water reactors. (JMJ)

16741 (JPRS-56318, pp 10-20) IMPROVING THE THERMAL CIRCUITRY OF SINGLE-LOOP ELECTRIC POWER STATIONS WITH CHANNEL-TYPE REACTORS. Morozov, G. N.; Zorin, V. M. Translated from Teploenergetika; No. 3, 4-8(1972).

For single-loop atomic electric stations, it is advantageous economically to increase the feedwater temperature to 195–206°C (at e_r = 0.5–1.1 kopeck/kWh), if the heating surfaces of the high-pressure heaters are made of carbon steel, and to 196–200°C (at e_r = 0.9–1.1 kopeck/kWh) if 1Kh18 stainless steel is used. The choice of the material for the heating surfaces of the high-pressure heaters can be made only after considering the different variants of water systems in the station. (auth)

16742 (JPRS-56318, pp 21-4) INCREASING THE USE OF SINGLE-LOOP ATOMIC ELECTRIC POWER STATION TURBINE CONDENSERS AS EMERGENCY MODE BLOWOFF STEAM RECEPTACLES. Al'tshuler, M. A.; Shavarin, V. N. Translated from Teploenergetika; No. 3, 8-10(1972).

A bubbler type condenser for a single loop boiling water reactor is described. The condenser, 3.6 m in diameter, and 21 m long is filled two thirds full of water. Steam, entering through pressure reduction valves, is directed in the water through nozzles and baffles. Power to condenser water pumps is reduced by a factor of 12 to 15 over that to standard steam condensers. (JMJ)

16743 FUNCTION OF THE STEAM GENERATORS IN NUCLEAR POWER PLANTS WITH PRESSURIZED WATER REACTORS. Schuecktanz, G. (Siemens AG, Erlangen, Ger.). pp 242-55 of Jahrbuch der Dampferzeugungstechnik. Essen; Vulkan Verl. (1972). (In German).

A brief description is given of the most important features of construction, design, manufacturing, and operating behavior of steam generators in PWR-type reactors. Included are the technical data of the steam generator of the Biblis nuclear power plant. (GF)

Propulsion and Auxiliary Power Reactors

Refer also to abstract 14690.

16744 (CONF-710532-(Vol.1)) PROCEEDINGS OF THE SYMPOSIUM ON NUCLEAR SHIPS, HAMBURG, MAY 10–15, 1971. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany). Studiengesellschaft zur Foerderung der Kernenergieverwertung in Schiffbau und Schiffahrt e. V., Hamburg (West Germany)). 1972. 571p. (In several languages).

Included are 25 papers on the technical and economic aspects of nuclear ships. A separate abstract was prepared for each paper. (HDR)

16745 (CONF-710532-(Vol.1), pp 3-20) OPERATING EXPERIENCES WITH THE N.S. "OTTO HAHN". Ulken, D.; Fock, H.; Kuehl, H.; Lehmann-Willenbrock, H.; Schumacher, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The first German and European nuclear ship, the N.S. "OTTO HAHN", started on its first trial trip under nuclear power on October 11, 1968. Before this date, the reactor plant had been raised from first criticality to 60% of normal output within the extremely short period of only six weeks by way of mooring

trials. Following extensive trial trips in the Baltic, the ship made its appearance in all German ports at the beginning of 1969 accompanied by short demonstration trips with technically interested circles. From the middle of March on, the proper test trips into the open sea followed, being extended over the whole of 1969. During those months, the reactor installation was exposed to extreme conditions of sea and climate under intense measuring programs, which also comprised research work of great interest and importance for the future improvement of this reactor system. Having at the beginning of 1971 undergone the routine inspections and classing, the ship started on the third phase of its activity, namely regular freight service. Along with this application the research work was continued all along, and moreover the ship was introduced to foreign countries in form of short trial trips and by informative longer demonstration trips with experts on board. All voyages undertaken by the N.S. "OTTO HAHN" could be run according to the provided itinerary. The reactor plant has proven itself fully equivalent to a conventional installation. Details of the experiences gained are discussed. (auth)

16746 (CONF-710532–(Vol.1), pp 21-36) MAINTENANCE AND REPAIR EXPERIENCE OF THE N.S. "SAVANNAH" Allen, R. R. (Todd Shipyards Corp., Galveston, TX). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The N.S. SAVANNAH has been in operation over ten years. During this time a substantial amount of maintenance and repair has been performed on the nuclear plant and associated systems. Maintenance and repairs can be broken down into two major categories which are inspection, calibration and repairs performed routinely as a preventative maintenance program and those repairs necessary because of equipment failure. The preventative maintenance program is primarily associated with the U.S. Coast Guard annual inspection. A major preventative maintenance program was performed on the electro-hydraulic-mechanical control rod drive system during the first refueling in 1968. The program included a complete electrical and mechanical overhaul of each control rod drive mechanism. There have been two major equipment failures during operation of the N.S. SAVANNAH. The first, in June 1965, was a failure of the primary canned rotor pumps. The pump failures were caused by a leak in the electrical terminal bushings which admitted air from the containment to the pump stator cavity during a 60 psig containment leak rate test. The four pumps were replaced with spares and subsequently repaired including installation of new cans. The second, in 1969, was a failure of several of the buffer seals. The seals were installed in 1961 and had lost their resilience. In addition, the operation of a seal return flow stop valve may have caused higher than normal pressure and several tests performed prior to the failure may have subjected the seals to excessive pressure. The buffer seal capsules were removed from the reactor head, disassembled and the seals were replaced. Maintenance experience with the SAVANNAH has been very good with only two major equipment failures in 10 years. (auth)

16747 (CONF-710532–(Vol.1), pp 37-49) PREPARATION FOR THE OPERATION OF THE "MUTSU". Kitagawa, J. (Japan Nuclear Ship Development Agency, Tokyo). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Nuclear Ship MUTSU of Japan is under construction for fitting-out her reactor systems at her support facility. N.S. MUTSU is expected to complete her fitting work by the summer 1972. Training of the nuclear ship personnel commenced in 1967. And they will participate in fuelling, critical test, power up test and sea trial. Training for the seamen to be assigned to the MUTSU has been carried out on the basis of the following policies: (1) Fundamental studies and practices shall be performed through adequate courses. (2) Send the trainees to the field of construction and fitting-out. (3) Train them by the MUTSU plant simulator. (4) Send some of the senior officers (Deck and Engine) to foreign nuclear ships, if possible. The seamen were appointed to the ship's crew. They are not only responsible for safe operation of the first nuclear ship of Japan, but some of them joined the nuclear ship project and partook the task of planning and preparation for nuclear shipping. And also they have the mission to investigate the technical problems from the experiences of the MUTSU operation at sea or in port and to prepare for the future development of nuclear shipping in this field. From the above points of view, the plan and present state on seamen recruiting, manning plan, seamen training, and the outline of the reactor plant simulator are described. (auth)

16748 (CONF-710532–(Vol.1), pp 51-80) ANALYSIS OF CORE PERFORMANCE AND THE FIRST REFUELLING OF THE N.S. "SAVANNAH". Gallagher, W. J. (NUS Corp., Rockville, MD); Kaiz, G. H.; Sorensen, J. N.; Kim, Y. S.; Hathway, C. W. 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The N.S. SAVANNAH has operated approximately 15,000 EFPH on its first core loading, based on 74 MW(t) as full power. At that time, the suitability of continuing to operate Core 1 by shuffling the four space Core 1 fuel elements into the old core was investigated. It was calculated that another 7750 EFPH of operation could be gained by this method (50% more than the original core). End-of-life physics tests were conducted on Core 1 and beginning-of-life physics tests were conducted on Core 1a (shuffled) to verify calculational methods. Calculations were made to predict thermal performance of the shuffled core in comparison with the performance of Core 1. It was found that the overall peaking factor for Core 1 a was approximately 15% higher than that for Core 1. Also, the control rod worth for Core 1 a was higher than that indicated for Core 1, resulting in a higher attainable reactivity addition rate for a rod withdrawal accident, one of the hypothetical accidents studied in the safety analysis. A detailed safety review of the shuffled core confirmed that Core 1 a could be safely operated under the general provisions of the reactor license. Subsequent physics tests performed on Core 1 a have indicated excellent agreement with the initial excess reactivity, reactivity coefficients and differential rod worths calculated. Reactivity follow over the first two-thirds of Core 1 a life also indicated excellent agreement with predictions. Further analysis has been carried out on a complete spare fuel loading (Core II), which was purchased as backup for Core 1. Calculations were made for several fuel management options to determine the fuel management scheme that would result in the longest core life or lowest fuel cost. After selection of the optimum fuel loading scheme for Core II, detailed physics, thermal-hydraulic and transient analyses were performed indicating Core II met all licensing requirements. Although this core has not been loaded to date, it has the capability of providing fuel for approximately five additional years of operation. The first refueling of the N.S. SAVANNAH was accomplished smoothly, timely and without any serious incidents. The four problems, which occurred during the outage, have been chosen for discussion: the proper operation of the Auxiliary Core Cooling System, the galling of one of the head closure studs, a fuel element which was left without cooling water for approximately forty minutes, and a blowout of a Swagelok fitting on the buffer surge line. Each of these problems presented its own difficulties—high radiation exposure, delay of the outage, possible fuel damage, and possible core damage. These problems were handled with little difficulty; and although each required some extension of time in the total refueling outage, no fuel was damaged or personnel overexposed. (auth)

16749 (CONF-710532–(Vol.1), pp 81-87) CLASSIFICATION REQUIREMENTS FOR NUCLEAR SHIP IN-SERVICE INSPECTION. Parker, T. W. (American Bureau of Shipping, New York). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The need for uniform requirements for in-service inspection of stationary nuclear power plants has led to the promulgation of national regulations in several countries. These regulations will prove helpful to the designers of future nuclear plants but many existing plants can comply with the requirements only to the extent that design features and construction details will permit. However, the basic philosophy and approach of these regulations appear to be sound and well received and they may provide an excellent basis from which marine reactor inspection rules can be developed in the near future. The major classification societies and regulatory agencies have included in their nuclear rules very little in the area of in-service inspection. This is due to the limited data available from the operation of nuclear merchant ships now in service and the fact that most classification regulations were developed and published prior to the recognition of many reactor plant inspection problems. Classification rules have a strong influence on the design of marine propulsion plants including requirements for post-construction surveys in the maintenance of the integrity of the ship through out its useful life. In the field of nuclear in-service inspection, it appears vital that the various classification and regulatory agencies investigate and ultimately develop detailed inspection requirements to assure the continued safety of the marine nuclear plant. Some of the areas which need to be considered are discussed. These areas include access limitations, remote inspection techniques, frequency and degree of surveillance and identification of the reactor plant systems which should be included in an inspection program. (auth)

16750 (CONF-710532–(Vol.1), pp 89-108) N.S. SAVANNAH OFFICER TRAINING PROGRAMS, LICENSING, EXPERIENCE, AND IN-SERVICE RESULTS. McCready, L. S. (Merchant Marine Academy, Kings Point, NY); Parker, C. W. 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Officer training for the N.S. SAVANNAH is conducted in the Department of Engineering's nuclear engineering study center located at the U.S. Merchant Marine Academy, Kings Point, New York. The officers are given an intensive 20 week academic program at Kings Point followed by about 4 months of equally arduous study of the reactor and its many systems aboard the ship. The trainees are then examined for their Reactor Operator's License by the U.S. Atomic Energy Commission. The selection procedures, the study program and schedules, laboratory work, Nuclear Merchant Ship Simulator training, "on board ship" training and the reactor operator's examinations are thoroughly discussed in detail. The courses given to SAVANNAH trainees covers a very wide range. Some courses are short, but others like nuclear physics run almost the whole duration. Laboratory work is featured and the trainees are given a heavy schedule of work on the SAVANNAH simulator and later on the control console aboard the ship. The curriculum is identical for both Deck and Engine officers that have been selected for the program. The class schedules are exactly the same. Specialized additional training programs in Health Physics, Water Chemistry, Electronics and Instrumentation and Nuclear Merchant Ship Management have been established. Reactor operators complete these additional programs and are further certified to perform corollary duties thus reducing the manning scale required to operate the ship safely. (auth)

16751 (CONF-710532–(Vol.1), pp 111-135) PWR DEVELOPMENT FOR NUCLEAR SHIP PROPULSION. SHIELDING STUDIES AND CONTROL OF THE GASEOUS ACTIVITY RELEASE. **Chinaglia, B.** (Societa Ricerche Impianti Nucleari, Saluggia, Italy); **Di Grazia, G.; Monti, D.; Servo, G.** 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The control of radiations from a shipboard reactor presents, in particular, two problems of design: shielding for n and γ radiations emitted by fixed sources, in a compact geometry layout; management of safe release of gaseous activity to satisfy the requirements of rapid access to the reactor containment after shut down. In the shielding design, the peculiar space, weight and dose rate limitations require an optimization study concerning the shielding materials and the differential shielding thicknesses on the bases of dose rate mapping. Special problems as streaming effects, optimum ratio of neutron and gamma dose rate contribution interrelations between the shielding design and the general mechanical design of the reactor are investigated in detail. Several codes were used in the calculations of the neutron and gamma propagation in the absorbing media such as: SABINE: one dimensional program based on the removal-diffusion model; QAD: three dimensional point kernel integration program. The reliability of said codes were tested against results obtained by a series of experiments of radiation attenuation at penetrations. The radiation transport through voids was computed by the MRC—1 code, which is based on the multiple reflections inside a cylinder and on the albedo technique. The release of the gaseous activity from a shipboard reactor presents operational problems somewhat different from that of a land based reactor. For a PWR these operation problems can be satisfactorily engineered by proper design of the ventilation systems. The activity level in the containment atmosphere during reactor operations is maintained below a maximum value by a periodic purging of the containment. Said maximum activity level is set to a limit compatible with the requirement for a safe complete purge of the containment for accessibility, when required. The leakage of the primary coolant to the secondary system sets operability limits to the reactor, when a certain value is reached. The maximum allowable limit was evaluated in a parametric way by determining the corresponding activity released by the condenser ejectors. (auth)

16752 (CONF-710532–(Vol.1), pp 137-186) TECHNICAL SAFETY PROBLEMS IN NUCLEAR NAVAL PROPULSION AS RELATED TO PORT ENTRY CONDITIONS. **Vinck, W.; Boos, H.; Luykx, F.; Maurer, H.** (EURATOM, Brussels). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

An outline of some important structural and operational precautions to be taken to prevent or mitigate hazards to the environment in normal or abnormal conditions of a nuclear group is presented, and means by which acceptance of a nuclear ship in foreign territorial waters and ports can be facilitated and standardized are considered. Some important items considered in engineered accident prevention and the mitigation of postulated accidents are: (1) mechanical aspects of the nuclear propulsion unit, special protection in seagoing conditions (e.g. collision, vibration). (2) provisions for emergency cooling systems in postulated accident situations affecting the primary circuit or in case of nautical accidents (e.g. stranding). (3) containment provisions and their long term operational requirements. (4) off-gas and ventilating systems for normal and abnormal operation, filtering equipment efficiency and testability. (5) liquid waste storage in sea-going conditions. (6) reliability of operation of items (2) and (4) and connection with (emergency) power supply. (7) importance of quality control and extent of periodic inspections of important equipment from the safety point of view. (auth)

16753 (CONF-710532–(Vol.1), pp 187-200) SAFETY AUDIT OF N.S. SAVANNAH'S COMMERCIAL OPERATIONS. **Honeywell, A. P.; Saltarelli, E. A.** (NUS Corp., Rockville, MD). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The work of the N.S. SAVANNAH Safety Audit and Inspection Committee in assuring that reactor operations are being conducted in accordance to reactor operating license and Technical Specifications such that ship operations produce no undue risk to the safety or the public is described. Unique safety features of floating nuclear plants, such as ability to be towed to a remote anchorage and natural double compartmentation of the reactor spaces, have been instrumental in acceptance and licensing of the SAVANNAH. These and other inherent safety features possible in nuclear ships are discussed as well as the general philosophies behind vessel port operations. Certain additional precautions have been placed on the operation of the ship by its license which were not originally anticipated. The problems of operation under the restrictions of reactor licensing are discussed and a review is given of the evolution of the reactor license and the significant changes that have been implemented to help mitigate these restrictions. Included among these restrictions are such items as the necessity to retain tugboats on the basis of "time to melt" the core and the inability of the ship's operators to take credit for naturally occurring fission product holdup and decay when calculating the maximum credible accident. The ship's incident reports are reviewed and discussed to demonstrate her degree of compliance with license and safety restrictions over this period of first commercial operation. (auth)

16754 (CONF-710532–(Vol.1), pp 201-213) DEVELOPMENT OF PRESSURE SUPPRESSION SYSTEMS FOR NUCLEAR SHIPS. **Seeliger, D.** (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg); **Aust, E.; Gielen, H.** 1972. (In German).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

An essential supposition for the verification of economic nuclear ships is the development of compact, space and weight saving reactor installations. This presents the task to develop new systems for the containment of nuclear ships, which are compact and essentially automatic and independent of outer energy sources. For the advanced pressure water reactor of the type EFDR as proposed for ship's propulsion a pressure-suppression design was developed. This is characterized by a compact cylindrical drywell, enclosing only the upper part of the pressure vessel, by a separation of the spaces of wetwell and expansion room, both of which have plane walls as ship compartments, by a small number of condensing tubes with a great length of submersion, and by a relatively small volume of water in the wetwell. In a tabulated comparison the main criteria of this unit are confronted to those of the American Bodega Bay tests, and those of the power station of Würgassen. This comparison reveals essential differences as to design data criteria and formation. The computer program developed for design data and optimization of the system is discussed and the results of the calculations concerning the variation of diameters, submerged length of the condensing tubes, and the volumes of drywell and expansion space are presented. With respect to the essential differences from the American test an experimental proof of the analytical investigations is considered mandatory. A test program is discussed and a description of the full-size test stand added. (auth)

16755 (CONF-710532–(Vol.1), pp 215-237) EXPERIMENTAL STUDIES ON PRESSURE SUPPRESSION CONTAINMENTS FOR NUCLEAR SHIPS, PART A. CONDENSATION OF VENTED STEAM IN THE WATER. PART B. IMPACT FORCES PRODUCED BY TWO-PHASE EFFLUENT. **Kozeki, M.** (Mitsui Shipbuilding and Engineering Co. Ltd., Tokyo); **Nakanishi, T.; Kuwahara, S.** 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Considering the application of the pressure suppression containment concept to nuclear ships, there are some problems. One of them is that when the accident happens, higher pressure buildup in the containment and greater temperature increase of water in the suppression chamber than those of the nuclear power stations would appear because of the compactness of the containment. Accordingly, it is worth while to understand the mechanism

of condensation of vented steam at the exit of the vent tube, the necessary submergence depth of the vent tube and the effects of motions and attitude of the ship. These problems were investigated under the conditions that the saturated steam (air content 0-50%, pressure 1.5-20 kg/cm^2) was vented through the orifice (diameter 2-50 mm) into the water (pressure 1-10 kg/cm^2, subcool 0-100°C) using microflash-photography and high speed films. The summary of the results is as follows. There are two patterns of vent; the periodic vent which generates large noise and vibration and the continuous one which is nearly silent. The transition of the periodic vent to continuous one appears when the ratio of the suppression water pressure to the steam pressure is nearly critical. The qualitative natures of the periodic vent and the transition are examined. The collapse of steam bubbles at the periodic vent are very rapid, and the equivalent condensation heat transfer coefficients at the surface of collapsing steam bubbles are the order of 2-3 × 10^5 kcal/m^{2}h°C and this value decreases when the air content in the steam increases. A formula for estimating the necessary depth of vent tube submergence is obtained from the data. The particular features are shown when the steam is vented upward, downward and horizontally. Because of the small capacity of the container, another problem is brought about, that is, impact and jet impingement forces produced by the two-phase effluent discharging from rupture at pipe or nozzle sections of the primary system give loads to machines and instrument apparatus neighboring to the rupture portion inside of the container. Therefore, to obtain basic information about the force is very important for the containment system design. The test facility installed consists of pressure vessel, container which is usable either dry or wet and the pipe rupture section in the container. A series of vessel blowdown experiments was carried out. The experimental parameters are: rupture pressure 50 ~ 90 kg/cm^{2}G, rupture diameter 0.5 inches ~ 1.5 inches, and the container state, i.e., dry or wet. Data are presented on the intensity variation of the impact force by distance from rupture point, its transient behavior after rupture, and blowdown phenomena such as the pressure-time transient in the system, as well as analyzed results. (auth)

16756 (CONF-710532-(Vol.1), pp 239-260) REACTOR SAFETY ASPECTS ACCORDING TO CLASSIFICATION PROCEDURE AND INFLUENCE OF SHIP AND REACTOR ACCIDENTS ON THE DESIGN OF THE PROPULSION PLANT. Mau, R.; Agena, H. H. (Germanischer Lloyd, Hamburg). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Accelerations by ship motion and shocks and vibrations on board pose special conditions. Contrary to a land based station spare parts, repair, and maintenance as well as maneuverability are closely linked to safety. Accident analysis has to recognize the special conditions of a seagoing ship. One of these questions is how far a reactor scram may be compensated by a power set back and some other concern the reactor accidents which may be linked to ship accidents. The design of the safety enclosure on board of a ship may—with increased reactor power—result in integration of parts of the hull as enclosure. This rules the limits of the allowable design pressure, necessitates an increasing leak-rate and poses problems of thermal expansion after loss-of-coolant accidents. Pressure suppression after a rupture of the primary system may be a requirement. The main views concerning the availability of the nuclear steam generator are presented. Special requirements for a reactor ship without emergency drive are highly redundant steam generation systems including main steam lines, a simple and sound design of the propulsion plant, and non-existence of poisoning effects, as well as undue thermodynamic behavior and control rod velocities. (auth)

16757 (CONF-710532-(Vol.1), pp 261-282) SAFETY PROBLEMS POSED BY NUCLEAR POWERED SHIPS. Weiss, P. (Bureau Veritas, Paris). 1972. (In French and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The tendency towards renewal of ideas and methods which appears in the field of the safety of land-based power stations for the solution of problems raised by their siting in areas with high density population may prove useful also for similar problems in the operation of nuclear ships. The general procedures of safety evaluation currently used or which could be envisioned in the future are examined. The features and limitations pertaining to these procedures are reviewed. Three types of methods are delineated: the current methods in shipbuilding, i.e., those relying for a part on experience and codified by rules dealing mainly with scantlings of machines and lay-out of systems in the ship; the methods making use of the consequence analysis of certain accidents which are retained as credible and especially of the maximum hypothetical accident; and the methods introducing probabilities and aiming towards a definition of the risk exhibited by the plant and the appraisal of the acceptability of this risk. The methods thus defined are applied to the safety evaluation of the main components of the ship and of her propulsive machinery. The general review is intended to characterize the present state of the technical development as regards the fulfillment of safety requirements. The arrangements limiting the consequences of external accidents such as collisions are discussed, together with the requirements to be met by the major components of the nuclear plant such as reactor pressure vessel and containment vessel. (auth)

16758 (CONF-710532-(Vol.1), pp 283-302) SOME CONSIDERATIONS FOR MATERIAL SAFETY AND SAFE OPERATIONS OF NUCLEAR SHIPS. Bosnak, R. J. (Coast Guard, Boston). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Nuclear ship safety is considered from the systems approach. Such treatment must necessarily discuss ship operations and personnel as well as ship and equipment material safety. It is noted that past emphasis has been largely of material. Nuclear ships are reviewed from the vantage point of today's relatively limited experience with regard to safety in operations at sea, in port entry situations and in ports, covering parameters such as emergency propulsion, collision protection, and ship maneuvering in restricted waters. The review includes Chapter VIII and Annex C of the Safety of Life at Sea Convention, 1960 with the purpose of making recommendations for changes which could be applied to future nuclear ships. A fault/event-safeguards solution matrix to use in the evaluation of the safety of the nuclear marine system is proposed. Utilizing such an approach the effect of a set postulated fault events on material, operations and personnel is discussed. The material considerations include hull structural strength intact and damage stability, containment, nuclear ship system construction requirements, and a treatment of conventional ship mechanical and electrical engineering systems. The problems of assuring a continued level of material safety of the marine nuclear power system throughout the life of the ship are discussed with emphasis placed on handling such requirements by instituting proper initial design innovations in equipment so that in-service inspections are facilitated. The problems of the persons involved during the periodic inspections and fueling of nuclear ships from the standpoints of training and experience, and exposure to radiation are mentioned. The emphasis is from the viewpoint of a classification society or safety administration surveyor or inspector. Personnel effects on ship operation, equipment operation, and the special skills found aboard nuclear ships are discussed. The inter-action between personnel and operations is covered to show how there should be a shift in emphasis from the "material" oriented fault event consequences minimization safeguard to "personnel" and "operations" oriented safeguards which are designed to prevent the fault event, or reduce its probability of occurring. (auth)

16759 (CONF-710532-(Vol.1), pp 303-325) SINKING VELOCITY MEASUREMENTS ON SHIP MODELS IN THE STUDY OF A REACTOR CONTAINMENT VESSEL. Hattendorf, H.-G. (Hamburgische Schiffbau-Versuchsanstalt GmbH, Hamburg). 1972. (In German).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

When a nuclear ship is sinking the flooding of the safety compartment containing the reactor is required at a certain depth of water in order to prevent the imploding of the compartment. In order to determine the size and the capacity of the flooding valves required, the sinking speed of the vessel must be known. The sinking speed was determined with the model of the N.S. "OTTO HAHN" built with all the important compartments at 1:70 scale. Later experiments were carried out with the model of a freighter with different lay-out of the main compartments and a differently arranged deck-house and lastly with the model of a passenger vessel. Additional under-water resistance tests at different angles of attack were carried out in order to check the calculations when transferring model data to full scale values according to Froude's law of similarity. In order to estimate the influence caused by the remaining air being compressed in the different compartments, which can not be done according to Froude's law of similarity and to correct for the slightly reduced spaces in the model relative to the full scale ship, additional tests were made, partly with greater air escape openings, partly with a greater sinking force. During the experiments the successive flooding of the different compartments was carried out according to a predetermined plan by openings directly to outboard provided with magnetic valves. A systematic flooding could be simulated with the ship sinking with bow or stern leading or on even keel. The vertical movements

of the model were measured and registered. Those of the aft part in one and of the fore ship in two directions. Later the position of the vessel was reconstructed according to the data measured for certain time intervals and by differentiation the sinking speed was determined for the fore and aft ship. The tests show that the sinking speed is mostly dependent on the sinking force and a state of equilibrium with constant sinking speed is reached at a depth of about 2½ to 3½ times the length of the vessel. The sinking speed measured during the experiments, slightly corrected for errors resulting from factors which can not be calculated according to Froude's law of similarity, corresponds with the values calculated theoretically by Woisin. For an ore-carrier of the size of and with the compartments arranged as in the "Otto Hahn", with the reactor positioned at 0.4L ahead of the after perpendicular a sinking speed max. of 14 to 15 m per sec. could be expected. (auth)

16760 (CONF-710532-(Vol.1), pp 327-352) PREDICTOR SYSTEMS FOR SAFER MANOEUVRING OF NUCLEAR SHIPS INTO PORTS. van Berlekom, W. B. (Statens Skeppsprovninganstalt, Goteborg). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Manoeuvering ships in confined waters implies a number of situations where a safer transit can be obtained if the ship's path in the near future can be calculated and presented to the officers on the bridge. Systems which can perform such calculations and presentations are known as predictor systems. At the Swedish State Shipbuilding Experimental Tank (SSPA) the possibilities of using predictor systems were investigated. Predictors were studied as a manoeuvering and navigating aid for manual steering and also as a part of a fully automatic manoeuvering and navigating system in a port approach. These investigations were carried out using the SSPA steering and manoeuvering simulator. The simulator consists of a bridge mock-up (with instruments as compasses, speed log etc.), a number of TV-screens on which a simplified but angularly true view of the surroundings ahead of the ship is given and finally an analog computer which performs the calculations of the ship's motions in consequence of commanded helm angles, propeller revolutions etc. and the calculation of the display on the TV-screens. Prediction of the ship's path implies that a mathematical model of the ship's motions is set up. With this model calculations of the ship's path in the near future can be carried out for specified values of helm angle etc. If the results from these calculations are presented in a suitable way e.g. on the radar PPI screen it is possible to evaluate quickly which helm angles etc. will give a safe transit. It should also be noted that in the predictions actual values of ship's course etc. are used as initial conditions so that continuously an updating is obtained. The predictions are calculated at suitable time intervals, which depend on the size of the ship. The complexity of the mathematical model depends to some extent on the desired length of the predicted path and available information on initial conditions, such as course etc. Predictions of the ship's path can also be used in a fully automatic navigation system in a port approach. It is assumed that the ship shall follow a prescribed path. Appropriate helm angles etc. are calculated so that this desired path is followed as close as possible. In such an automatic system it is also possible to incorporate effects of cross currents, wind etc. (auth)

16761 (CONF-710532-(Vol.1), pp 353-365) PASSIVE AND ACTIVE COLLISION PROTECTION INCLUDING MODEL TESTING. Woisin, G.; Milde, M. P. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). 1972. (In German).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The various possibilities of providing for the protection of a marine reactor against collision damages entailing a radiological endangering of the environment may be subdivided into so-called active and passive protection measures. Active protection prevents collisions in the first order while passive protection reduces the extent of collision damage. The latter may be relied upon if the active protection becomes ineffective due to technical or human deficiency on the own or the other ship. Institutions for active or passive protection should in any singular case be compared by investments and gain in safety. Active protection consists in improvements of the manoeuverability or navigational facilities in one or both ships. The first nuclear ships have already been provided with more or better manoeuvring installations than usual additional to their passive protection of the reactor. In the future, a reactor ship may have a board computer to be applied for avoiding collisions also, as already in use for some conventionally driven ships. The design of a passive protection against collisions is getting more difficult due to the increasing size and speed of most new ships. Moreover, the common rather stiff bulbous bow has come to be fitted to all kinds of big and fast ships. Today it is not possible to choose the ideal way of prescribing by international agreements for all potentially dangerous ships "soft bows" with restricted resistance in longitudinal direction. The structure of a collision protection on a nuclear ship may be designed either according to the principle of a flexible zone or to the principle of a rigid wall. At present, only the first type has been applied to merchant nuclear ships, as the second principle needs collision model tests to be performed. Such model tests have already been made with three designs of a flexible protection for the N.S. "OTTO HAHN" with good success. The ship's side models were inserted into special bending beam constructions in order to avoid a membrane effect of the hull, which would not represent the real conditions. (auth)

16762 (CONF-710532-(Vol.1), pp 369-395) FIAT-ANSALDO-EURATOM ASSOCIATION PROGRAM FOR NUCLEAR SHIP DEVELOPMENT. Cesoni, G. (FIAT, Turin); Businaro, U. L.; Chinaglia, L.; Mori, G.; Faresi, R. 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

An association contract was signed on Dec. 15, 1961 among Euratom, Fiat and Ansaldo for a study and development program for a nuclear tanker. The work for the contract covered a time span from 1961 to 1970. Four reactor types were compared: a forced circulation PWR, a natural circulation PWR, a direct cycle BWR and an indirect cycle BWR. A reference design was developed based on a forced circulation PWR, selecting a number of improvements to be studied, such as: use of chemical shim for a shipboard reactor; integration of the primary system in the reactor vessel; vapor condensation in the reactor containment; self pressurization. The study of these improvements led to the design of an improved PWR system. The research and development program, which was started since the beginning of the program, received impetus and focus after the finalization of the reference design, and included investigation on a large number of items. The ship design was based on a medium size tanker as prevailing in the early 1960 years. Extensive design work was performed on ship structures of general interest with reference in particular to the anticollision structure. Several collision tests on a 1/15 scale were performed simulating different anticollision barriers and typical collision conditions. (auth)

16763 (CONF-710532-(Vol.1), pp 397-414) PWR DEVELOPMENT FOR NUCLEAR PROPULSION: VIBRATION ANALYSIS OF NUCLEAR POWER PLANT. Garro, A.; Roberti, R.; Verona, E.; Zanghirella, E. (FIAT, Turin). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The detailed calculation of transient mechanical stress fields in reactor components is a formidable analytical task for any applications. In the case of shipboard applications the task is more demanding due to the necessity to consider in the analysis the entire ship structures to determine input conditions on each reactor component, and due to the different environment conditions. A program to develop suitable analytical calculation procedures applying them to a specific case of shipboard reactor has been developed and the results are presented, with reference in particular to the calculation of the stresses due to shock on a structure and the estimation of the single component fatigue. The structure is a nuclear ship propulsion plant and the exciting forces consist of a system of forces from the hull beam. The complexity of the system must be analyzed considering every component as a substructure self-supporting. Using special techniques, all the substructures are studied one-by-one, firstly; then the stiffness matrices are connected using a code to obtain the stiffness matrix of the whole structure: with this matrix the dynamical analysis can be made and the frequencies and the associated modal forms are obtained. Connected to the vibration of the structures the problems of sloshing due to the presence of liquid inside and outside the structures are investigated using a matrix technique of coupling liquid and structure together with their mutual interaction. Some considerations on sloshing permit the analysis of special components as, for instance, the steam generator, examining particularly the response of the structures and of the U-tubes of the bundles with the evaluation of the displacements of response. A finite-element code has been used in order to analyze stresses in particular zones of the plant structures. The results obtained show that for a plant of the afore-said type, it is not possible to study only a small number of masses but all the components must be analyzed in detail in order to take into account the mutual interactions. (auth)

16764 (CONF-710532-(Vol.1), pp 415-429) OPERATION OF PRIMARY CIRCULATING PUMPS IN INTEGRATED PWR, AND THE DESIGN CRITERIA FOR AUXILIARY SYSTEMS OF PWR

FOR MARINE APPLICATIONS. Hunter, J. D. (Interatom, Bensberg, Ger.). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The basic problems associated with the operation of circulating pumps mounted at the side of compact integrated water reactors are discussed. Four main circulating pumps are located symmetrically around, and adjacent to, the lower part of the pressure vessel so that the suction intakes are beneath the steam generator. The pumps themselves are of the vertical propeller type, directly coupled to a canned rotor motor and mounted in pressure tubes which form part of the pressure vessel itself. The primary-water filled and lubricated motor is cooled from an auxiliary cooling system. By means of poleswitching induction motors the pumps can be driven at 725 or 1450 rpm. During all phases of reactor operation it is essential that the net pump suction head (NPSH) available be maintained above that specified by the manufacturer. The required NPSH is a function of pump speed and discharge, and is dependent upon the design of the housing and runner inlet. Under normal load operating conditions of the reactor the primary water is adequately undercooled so that the available NPSH exceeds the required value. The normal manoeuver load for a tanker or container ship lies in the range 11–13% of rated reactor output, and the 'hotel' load (i.e., ship docked with only the minimum essential auxiliaries in operation) is estimated at about 5%. Because of the compact design and increased specific output of the EFDR reactor, it is necessary to switch the pump motors from full to half speed at approximately 8% load. This takes place automatically with rising primary side outlet temperature from the steam generator. The switching point lies well below the lower range limit of power load operation. During the reactor start-up and shut-down procedure, at times when no undercooling is available over the steam generator, it will be necessary to supply a small gas overpressure in the free space above the water surface to ensure that cavitation does not occur at the pumps. This gas pressure will be maintained as small as possible by operating with only one or two primary circulating pumps at half speed. To avoid the necessity of a gas overpressure during reactor warm-up the use of slower running motors and alternative forms of speed control are being investigated. (auth)

16765 (CONF-710532–(Vol.1), pp 431–450) ADVANCED PWR'S AS PROPULSION PLANTS FOR NUCLEAR SHIPS INCLUDING HIGH POWER SYSTEMS. Andler, M. (Interatom, Bensberg, Ger.); Fischer, R.; Hedemann, H. J. 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The advanced pressurized water reactor FDR with an integrated primary system has proved itself well during its two years of operation in the N.S. "Otto Hahn." The further development of this reactor type, and in particular the special advantages of its integrated design for marine propulsion units as well as its extrapolation for larger power outputs are described. (auth)

16766 (CONF-710532–(Vol.1), pp 451–468) SPECIAL PROBLEMS DURING THE ERECTION AND STARTUP PHASE OF THE "OTTO HAHN" REACTOR AND CONSTRUCTION ASPECTS FOR FUTURE DESIGNS. Koellmann, R.; Vogt, F.; Weiss, G.; Hendl, G. (Interatom, Bensberg, Ger.). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Several special problems during the erection and start-up-phase of the nuclear propulsion unit for N.S. "Otto Hahn" are discussed. Based on the experience gained, construction aspects and pertinent action are suggested towards the performance of erection and commissioning of optimizing future marine reactor systems. The design requirements for control rods and containment are described in detail. (auth)

16767 (CONF-710532–(Vol.1), pp 469–486) TWO ALTERNATIVE PLANTS FOR NUCLEAR PROPULSION OF LARGE CONTAINER SHIPS. Muysken, M. (Reactor Centrum Nederland, Petten, Netherlands). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The Reactor Centrum Nederland and the Rotterdam Dockyard Company have evaluated the technical implications of applying nuclear power to large high speed container ships, powered by 120,000 SHP. Two different types of PWR reactors, the loop type and the integral type, have been taken into account and compared. Both reactor plants can be designed so as to fit in the space required for the conventional boilers for a same size of plant, in front of the main engine room. The design changes necessary for the ship have been studied in more detail for the loop type reactor. The weight of the light ship with the nuclear plant is calculated to be about 2400 tons more than the conventional ship, and about 3000 tons more permanent ballast will be necessary, if a conservative approach is taken when designing the secondary shielding and the support of the containment vessel in the ship. This total of about 5400 tons extra weight is of the same order as the weight of fuel supply required for the conventional ship. (auth)

16768 (CONF-710532–(Vol.1), pp 487–515) PWR DEVELOPMENT FOR NUCLEAR SHIP PROPULSION: PRIMARY SYSTEM COMPONENTS DEVELOPMENT. Cavallero, D.; Ghia, G.; Malambri, P. (FIAT, Turin). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Shipboard reactor applications pose specific requirements to reactor components design, somewhat different from the case of land based reactors. This is due not only to the different reactor power ranges, but to the specific shipboard environment conditions. Reference is made in particular to: primary coolant isolation valves required in case of a multi-loop arrangement to assure reactors operation at a reduced power in case of malfunctioning of one loop components. Ease of operation, simplicity of design and zero coolant leakage are premium design characteristics; control rod drive mechanisms which should assure rod insertion in any position of the ship and the avoidance of rod movement in the case of ship capsize; piping systems which should be designed to meet the contradictory requirements of flexibility in a reduced space with high dynamic mechanical stresses due to ship motion and vibrations. A program has been performed to develop specific design for such key reactor components, which have led to component prototype manufacturing and testing. The design criteria, the theoretical analyses, and the tests performed on the component prototypes are presented in order to demonstrate the required performance and the adequacy to the application. (auth)

16769 (CONF-710532–(Vol.1), pp 517–528) NUCLEAR AND THERMOHYDRAULIC DESIGN OF SELF-PRESSURIZING SHIP REACTORS. Henssen, H.; Mueller, E.; Quast, U.; Rossbach, W.; Wickert, M. (Interatom, Bensberg, Ger.). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

In order to make maximum use of many years of experience in light water reactors the design of the EFDR is chosen to follow the design of land based light water cores whenever it is feasible. The special conditions for ship propulsion reactors which lead to additional considerations in the nuclear and thermohydraulic design of the core are briefly described. The most important conditions are the limited power demand, the acceleration forces and the stuck rod criterion. These design considerations are discussed in the following problem areas: (1) Determination of the pin lattice parameters. An optimization study of the lattice parameters showed that typical PWR pin diameters are well within the optimum range of EFDR lattices. (2) Investigation of fuel element size and fuel management leads to large fuel elements and a four zone reloading pattern, using lumped burnable poison for additional reactivity control. (3) The economic incentive to go to higher power densities is studied considering the fact, that this results in smaller cores with increased neutron leakage, but also allows higher average discharge burnup and results in savings for the plant costs. (auth)

16770 (CONF-710532–(Vol.2)) PROCEEDINGS OF THE SYMPOSIUM ON NUCLEAR SHIPS, HAMBURG, MAY 10–15, 1971. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany). Studiengesellschaft zur Foerderung der Kernenergieverwertung in Schiffbau und Schiffahrt e. V., Hamburg (West Germany)). 1972. 558p. (In several languages).

Separate abstracts are included for each of the 29 papers presented on marine reactor development, and economic and legal aspects of marine reactor operation. (DCC)

For abstracts of individual papers see: 16771–16799.

16771 (CONF-710532–(Vol.2), pp 529–540) POWER DENSITY INCREASING STUDIES AND MODEL CALCULATIONS OF THE AVERAGE DENSITY OF SUB-COOLING LIQUIDS IN THE REACTOR. Hein, D. (Maschinenfabrik Augsburg-Nuremberg AG, Nuremberg); Koehler, W.; Katsaounis, A. 1972. (In German).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The nuclear research laboratory of Maschinenfabrik Augsburg–Nürnberg AG carried out experimental work on behalf of the GKSS on fuel element segments of the integrated pressurized water reactor and an advanced version with increasing power density. The investigations involved a reduction of uncertainty factors in

core design by an improved understanding of thermo-hydraulic processes in the core and a study of engineering features apt to improve flow conditions. Various influences of spacers and hot channel factors on burnout were investigated and capability limits determined. Spacers with short twisted tapes were developed and tested to increase power density which succeeded in raising critical heat flux by 20%. Further experiments were designed to study inception of boiling in high heat flux channels and the growth and condensation of vapour bubbles in sub-cooled flow and the influence of these phenomena on pressures losses. The experiments done to determine the burnout by FDR-geometry and operating conditions, which were evaluated by MAN on behalf of the GKSS, were correlated with four burnout correlations. The result showed that the W2-burnout relation values were favorable in comparison with the experiment and with other burnout-equations. The calculated values of void fraction were satisfactory with the measured values in a simple channel-geometry (round tubes, rectangular channels, etc.). The experiments were done in a rectangular channel which included 9 rods. For the correlation of the experimental data a computer program with a mixing code for the sub-channel-analysis is used. 17 references. (auth)

16772 (CONF-710532-(Vol.2), pp 541-562) PWR DEVELOPMENT FOR NUCLEAR SHIP PROPULSION: REACTOR CONTROL AND IN-CORE INSTRUMENTATION SYSTEM DESIGN. Basile, F.; Merino, R.; Selvaggi, G. (FIAT, Turin). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The basic features and the design principles of the reactor control and in-core instrumentation systems for a nuclear shipboard reactor are presented. The very stringent maneuvering requirements specified for this application, coupled with the poor heat transfer characteristic of a ceramic fuel core, have determined some hard problems in the plant control system design. The control system consists of two subsystems, namely "power control system" and "temperature control system," providing an adequate prompt reactivity variation and long term reactivity compensation able to restore, within its deadband, the reference value of the coolant average temperature. A complete program for designing, manufacturing and testing an in-core neutron flux mapping system, whose flexibility characteristics are able to meet the peculiar requirements of a shipboard reactor with its space limitations, has been carried out. The main features of the system are described. (auth)

16773 (CONF-710532-(Vol.2), pp 563-580) PWR DEVELOPMENT FOR NUCLEAR SHIP PROPULSION: SHIP MOTION EFFECTS ON NUCLEAR STEAM GENERATOR PERFORMANCE. Secolo, N.; Selvaggi, G. (FIAT, Turin). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The main theoretical and experimental programs carried out by FIAT in order to attain a steam generator design able to assure good steam generator performances in the presence of wave motions are described. After a brief general description of the digital computer codes developed and used to define steam generator steady state and transient operating conditions, the following main points are discussed: recirculation loop pressure drop experiments, performed on a full scale partial model in order to verify theoretical predictions on pressure drops across the baffles and across the orificing ring (whose pressure drops depend on its position in the downcomer region); recirculation loop thermohydraulic stability studies, performed in order to obtain, with and without ship motion effects, optimal positioning of the dumping ring, just provided in the downcomer region; allowable steam quality range, at the inlet of the swirl vane, with reference to the steam separators efficiency; and steam generator transient behavior and level control system general characteristics. (auth)

16774 (CONF-710532-(Vol.2), pp 581-616) PWR DEVELOPMENT FOR NUCLEAR SHIP PROPULSION. Chinaglia, L.; Cesoni, G.; Criscuolo, L.; Previti, G. (FIAT, Turin). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

An extensive program has been performed by FIAT aimed at the construction of a high performance reactor for ship propulsion of a PWR type. Agreement for the actual construction phase has not finalized yet, but the program has been developed up to the point of detailed design, development and testing of key components, simulation experiments on core vessel hydraulics, internals vibrations, etc. A general introduction on the overall program and a detailed description of the nuclear and thermohydraulic design is presented. 20 references. (auth)

16775 (CONF-710532-(Vol.2), pp 617-634) DESIGN CHANGES TO THE N.S. SAVANNAH. Honeywell, A. P. (NUS Corp., Rockville, MD); Crook, D. L. 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Since the SAVANNAH's design was firmly established, over 300 changes in design have been implemented. Why these changes to the world's first nuclear merchant ship were thought necessary, what affect they had on Ship operations, and what considerations were raised by the changes are discussed. (auth)

16776 (CONF-710532-(Vol.2), pp 635-645) DEVELOPMENT AND TESTING OF A COMPACT WATER-OPERATED HYDRAULIC SYSTEM FOR SCRAM AND CONTROL ROD DRIVES. Anders, H.; Hein, D.; Meusel, W.; Waldschmidt, K. (Maschinenfabrik Augsburg-Nuremberg AG, Nuremberg). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

A canned (glandless) control rod and scram rod drive system using primary circuit water has been evolved for water-cooled reactors. The system essentially comprises a cylinder, a working piston, latching device and rod position indicator integrated into a compact unit, the length of which is less than double its stroke. The straightforward design makes this equipment suitable for actuating control, trimming and scram rods. The drive, pressure accumulator and valve block can be combined in a single unit with the former two elements located inside the reactor pressure vessel. After examination of the individual sub-assemblies and testing of the prototype drive assembled from them up to reactor conditions, the drive, being specially suitable for installation in marine reactors, is scheduled to be tested on the roll and pitch test rig of the GKSS which simulates the motions of a ship. (auth)

16777 (CONF-710532-(Vol.2), pp 647-654) DESIGN PROBLEMS OF MERCHANT SHIPS WITH NUCLEAR PROPULSION. Lettnin, H. K. J. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg); Kayser, F. K. 1972. (In German).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The specific differences between conventional and nuclear powered merchant ships are described. After a short review of the future development of nuclear propulsion, the question of bunkering and action radius for nuclear ships is discussed considering the lifetime of the core [1]. The deplacement relations are analyzed showing the advantages and disadvantages of conventional and nuclear power plants. (auth)

16778 (CONF-710532-(Vol.2), pp 655-668) TRANSPORT SYSTEM FOR NUCLEAR SHIPS. Schafstall, H. G.; Ermisch, K.; Rossberg, K. E. (Fried Krupp GmbH, Maschinenfabriken, Essen). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Taking the specific advantages and disadvantages, considerations are given to various ocean-going transportation systems which can utilize the advantages of nuclear power drive and avoid the disadvantages as far as possible. Based on the present stage of development of nuclear power drives, the specific features of nuclear power drive plants are shown in comparison to conventional plants. This results in certain demands which determine the economy and workability of nuclear ocean-going systems. (auth)

16779 (CONF-710532-(Vol.2), pp 669-696) ADAPTION OF NUCLEAR PROPULSION TO A CONTAINER SHIP. Chevallier, J. (Compagnie Centrale d'Etudes Industrielles, Rueil-Malmaison, France); Dequenes, P.; Clement, P.; Rupaud, M.; Andrieu, J. L.; Havard, J.; Bonnet, Y.; Verdeau, J. J. 1972. (In French and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The installed shaft horsepowers of the container ships that are now under construction are so large that the use of nuclear propulsion seems to become economical for this type of ship. The minimum value of the savings that could be obtained with nuclear propulsion is analyzed. The reactor is a non-integrated pressurized light water reactor with two loops. (auth)

16780 (CONF-710532-(Vol.2), pp 697-722) SOME DIFFERENCES BETWEEN CONVENTIONAL AND NUCLEAR CONTAINER SHIPS WITH EQUAL CARGO CAPACITY AND SPEED. van Berkel, P. B. (Sea Transport Engineering N.V., Amsterdam); Vinke, W. 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Sea Transport Engineering developed a computer programme for calculating the main particulars of large and fast container ships, based on a number of input data such as: number of containers, speed, weight per container, range, type of propulsion

installation, etc. All vessels have steamturbine propulsion. Conventional ships have a steam supply system with oil fired boilers. Nuclear ships are equipped with a PWR-installation with heavy concrete shielding. Using a number of calculated examples in the speed range from 25 to 35 knots with a capacity of 1500–3000 twenty feet containers, the differences between conventional and nuclear ships are discussed. The influence of design parameters, i.e., weight per container, range, restriction of main dimensions, will be taken into consideration. (auth)

16781 (CONF-710532–(Vol.2), pp 725-744) DESIGN AND CONSTRUCTION OF THE MUTSU. Inouye, M. (Japan Nuclear Ship Development Agency, Tokyo). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The purpose of the construction of the MUTSU is to obtain the experiences on nuclear ship building and operation to accumulate the necessary data for future development. The MUTSU is an experimental nuclear ship of about 8,000 gross tonnage with 36 MW(t) pressurized water reactor. Design parameters for the ship are presented. (auth)

16782 (CONF-710532–(Vol.2), pp 745-760) REACTOR DYNAMIC EXPERIMENTS WITH THE "OTTO HAHN" REACTOR FDR. Kolb, M.; Fiebig, R.; Robinson, E.; Schwieger, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). 1972. (In German).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Experiments done within the GKSS research programme on the physical and technical aspects of the "Otto Hahn's" nuclear steam generator are described. Special instruments were installed at the FDR which worked well under extreme conditions of operating temperatures, vibrations and the ship's motion. The reactor dynamic experiments have two main missions: the influence of the accelerations caused by the sea on the operation of the reactor and analysis of the self-regulating properties of the new FDR-system. (auth)

16783 (CONF-710532–(Vol.2), pp 761-774) SECOND CORE OF THE N.S. "OTTO HAHN": NUCLEAR, THERMOHYDRAULIC, AND FUEL ELEMENT DESIGN. Mueller, E. (Interatom, Bensberg, Ger.); Rossbach, W.; Schinner, A.; Will, W.; Fricke, W.; Friedrichs, H.; Guse, K.; Buenemann, D.; Manthey, H.-J.; Mueller, A. 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The successful operation of the first core of the "N.S. Otto Hahn" reactor showed the feasibility of the FDR-type for nuclear ship propulsion. The operation of a second more advanced core shall provide information and experience for future cores with low fuel cycle costs. Design parameters for the second core are presented. (auth)

16784 (CONF-710532–(Vol.2), pp 775-792) SHIP-PROPULSION SYSTEM WITH HIGH-TEMPERATURE REACTOR AND GASTURBINE. Bammert, K. (Univ., Hanover); Krey, G.; Boehm, E. 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Investigations have shown that a ship-propulsion system with high-temperature reactor and gas turbine has several advantages and, therefore, is of interest for the future: such a plant only has small overall dimensions, realizes the requirements for good maneuvering capability and controllability in a wide speed and power range, and has a high total efficiency. With regard to the high-temperature reactor, helium is used as cooling medium, which serves as the working fluid of the turbine (single-cycle system). In such a single-cycle system the interaction of reactor and turbine during normal operation is of great importance. The operational behaviour of such a plant having an output of 33,000 hp and using a controllable pitch propeller is analyzed. The turbo set is a twin-shaft design, the high-pressure turbine being coupled with the compressors on a separate shaft and the low-pressure turbine driving the propeller and two 2-MW-alternators via a gear. Pressure and temperature at reactor outlet amount to 60 bar and 850 deg C. (auth)

16785 (CONF-710532–(Vol.2), pp 793-808) AN ASSESSMENT OF NUCLEAR PROPULSION: A CHALLENGE FOR THE SEVENTIES. Pitkin, M. (Maritime Administration, Washington, D. C.). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The U. S. Maritime Administration is pursuing an aggressive research and development program which has as its objective improvement of the competitive position of the U. S. merchant marine industry in worldwide commerce. A major element of the overall R & D effort is devoted to an Advanced Propulsion Systems Program which includes both conventional and nuclear propulsion. The U. S. Nuclear merchant ship program from its inception in 1965 with the start of the N.S. SAVANNAH up to the current activity is reviewed. The current status of commercial nuclear propulsion from the point of view of the U. S. ship operator is described. (auth)

16786 (CONF-710532–(Vol.2), pp 811-833) ECONOMIC COMPARISON BETWEEN NUCLEAR AND CONVENTIONAL TANKERS AND CONTAINERSHIPS. Ager-Hanssen, H.; Spongsveen, J. (Institutt for Atomenergi, Kjeller, Norway). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Based on design and development work on direct cycle boiling water reactors for ship propulsion, an economic comparison between nuclear and conventional tankers and containerships has been performed. The results of the study indicate that under present conditions nuclear ships are inferior to conventional ships. For tankers the breakeven power rating ranges from 75,000 to 130,000 shp, depending on the limitations in capital investment or cargo volume imposed. These power ratings correspond, however, to speeds (22–25 knots) far beyond the optimum (13–16 knots). For containerships no breakeven power rating was found for the smaller ship sizes. For a 50,000 tcdw ship, a break-even power rating of 90,000 shp was found, which again corresponds to a speed (~28 knots) far beyond the optimum (18–21 knots). 11 references. (auth)

16787 (CONF-710532–(Vol.2), pp 835-842) FACTORS INFLUENCING THE CHOICE OF NUCLEAR POWER FOR CONTAINERSHIP PROPULSION. Rouse, J. R. (Vickers Ltd. Shipbuilding Group, Barrow-in-Furness, Eng.). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The important parameters that may influence the future development of commercially viable nuclear powered container ships are analyzed. The study illustrates the sensitivity of relative profitability of both forms of propulsion system to systematic changes in basic parameters, and indicates particular combinations of parameters likely to produce optimum designs for vessels operating over specific routes. 6 references. (auth)

16788 (CONF-710532–(Vol.2), pp 843-876) ECONOMIC ASPECTS OF NUCLEAR MERCHANT SHIPS. Bianchi, H.; Kayatz, P. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt mbH, Hamburg). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The known evaluations of economic feasibility of nuclear powered merchant vessels are compared. The influence of relevant technical and economical factors is analyzed. (auth)

16789 (CONF-710532–(Vol.2), pp 877-890) FUEL CYCLE COST CALCULATIONS FOR A 120,000 SHP PWR FOR SHIP PROPULSION. Dekker, N. H. (Reactor Centrum Nederland, Petten, Netherlands); Nolson, D.; Slobben, J.; Foggi, C.; Giacomazzi, G. 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

In connection with a study on nuclear propulsion for large high speed container ships being performed in the Netherlands a set of fuel cycle cost calculations for a 120,000 shp PWR plant is presented. The fixed parameters for these calculations are the thermal power for the reactor (320 MW(t) and a load factor of 70%. Several parameters are varied while performing the calculations, for instance fuel rod diameter, water to uranium ratio in the core and length of refuelling cycle. Refuelling cycles with batch loading and 1000 equivalent full-power-operating-days between refuelling, as well as cores with partial loading after 500 equivalent full-power-operating-days, are studied. 9 references. (auth)

16790 (CONF-710532–(Vol.2), pp 891-906) POSSIBLE USE OF NUCLEAR CONTAINERSHIPS FOR ITALIAN MERCHANT MARINE TRADE. Cavaggioni, M.; Crisa, V.; Maturo, G.; Rubbi, L.; Salvati, I. (CNEN, Rome). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The parameters influencing the competitiveness of nuclear power for merchant ships are analyzed. For different routes and trade, the power, velocity and capacity limits determining competitive conditions are discussed. The influence of cargo handling capacity and nuclear power economic parameter variations are analyzed. 9 references. (auth)

16791 (CONF-710532–(Vol.2), pp 909-924) HARMONIZATION OF CERTAIN MARITIME NUCLEAR CONVENTIONS IN RE-

SPECT OF THE THIRD PARTY LIABILITY FOR NUCLEAR DAMAGE. Strohl, P. (European Nuclear Energy Agency, Paris). 1972. (In French and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The activity inherent to maritime application of nuclear power might provoke legal difficulties. These difficulties arise from eventual conflicts caused by the concurrent application of maritime and nuclear convention in case of damages done by fissile or radioactive material which might escape on the occasion of these activities. These nuclear conflicts will be examined for the three following cases: sea transport of nuclear material, nuclear installation in maritime applications, and nuclear powered ship. It is necessary to harmonize the nuclear and the maritime law. Some possible solution is given. (auth)

16792 (CONF-710532-(Vol.2), pp 924-936) REFLECTIONS ON INTERNATIONAL AGREEMENTS COVERING THE TRADING IN FOREIGN WATERS OF THE "OTTO HAHN". Breuer, G. (Bundesministerium fuer Verkehr, Hamburg). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The Federal Republic of Germany had to conclude with countries at whose ports the nuclear vessel "Otto Hahn" was intended to call certain international agreements. These agreements are described. (auth)

16793 (CONF-710532-(Vol.2), pp 937-947) LEGAL PROBLEMS OF THE ADOPTION OF THE BRUSSELS CONVENTION ON THE LIABILITY OF OPERATORS OF NUCLEAR SHIPS OF 25th MAY 1962 INTO GERMAN LAW. Pelzer, N. (Univ., Goettingen, Ger.). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

In the German Federal Republic the ratification of the Brussels Convention on the Liability of Operators of Nuclear Ships of 1962 is at present under deliberation with a view to laying the foundation for an international harmonization of the law and at the same time to facilitate the voyages of the German reactor ship "Otto Hahn." The adoption of the Convention poses a number of important questions, as the principle of the legal "canalization" of liability onto the operator is new and to a great extent contrary to the system of German law. The legal problems arising in this connection are dealt with and other questions concerning the adoption of the Convention into German law are examined. (auth)

16794 (CONF-710532-(Vol.2), pp 949-956) EVOLUTION OF ITALIAN LEGISLATION CONCERNING NUCLEAR SHIPS' OPERATIONS AND NUCLEAR TRANSPORTS. Carbone, F. (Centro Italiano di Studi di Diretto dell'Energia Nucleare, Rome). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

16795 (CONF-710532-(Vol.2), pp 957-970) FRENCH LEGISLATION RELATING TO NUCLEAR SHIPS. de Nercy, M.; Lagorce, M. (CEA, Paris). 1972. (In French and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Without waiting for the entry into force of the Brussels Convention of 25 May 1962, France has introduced legislation on third-party liability of operators of nuclear ships (law of 12 November 1965, as amended) and laid down the conditions for access of foreign nuclear ships to French territorial waters and ports (Decree of 19 June 1969, bilateral Governmental agreements). The operator of a nuclear ship bears full legal responsibility, to the exclusion of all other persons, for nuclear damage. The entry of foreign nuclear ships into French territorial waters and ports is subject to authorization. An agreement between the Governments concerned must lay down, in each case, the guarantees to be furnished by the country under whose flag the ship is sailing and by the ship's operator. Bilateral agreements are now being discussed with the United States (for the "Savannah") and the Federal Republic of German (for the "Otto Hahn"). Essentially these are patterned closely after the International Convention on the Safety of Human Life at Sea, signed in London in 1960. (auth)

16796 (CONF-710532-(Vol.2), pp 971-986) REACTOR SHIPS IN FOREIGN TERRITORIAL AND INTERNAL WATERS AND THE PUBLIC INTERNATIONAL LAW OF THE SEA. Pelzer, N.; Rauschning, D.; Zieger, G. (Univ., Goettingen, Ger.). 1972. (In German).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The main problems of public international law concerning entry of reactor ships into foreign waters are examined: innocent passage of reactor ships in territorial waters; access of reactor ships to maritime ports; entry of reactor ships in distress into territorial waters and ports. Reactor ships which comply with the conditions of the SOLAS-Convention and whose risk is covered by a suitable liability law (e.g., Brussels Convention on Reactor Ship Liability) generally fulfill the minimum conditions which are to be met before entry into foreign waters. (auth)

16797 (CONF-710532-(Vol.2), pp 987-1006) STATUTORY PROVISIONS FOR NUCLEAR-PROPELLED SHIPS: A COMPARATIVE REVIEW OF NATIONAL LEGISLATION AT PRESENT IN FORCE. Bischof, W. (Univ., Goettingen, Ger.). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

It is noteworthy that the international legal basis for this new kind of sea traffic and also for harmonization of the national statutory provisions was laid down right at the outset of the growth of nuclear navigation by international treaty. The international treaties in question are the International Convention for the Safety of Life at Sea of 1960 (the SOLAS-Convention) and the Brussels Convention on the Liability of Operators of Nuclear Ships of 1962. Special legal provisions concerning marine reactor safety are described. (auth)

16798 (CONF-710532-(Vol.2), pp 1007-1012) N.S. SAVANNAH: THE INSURANCE STORY. Lane, W. H.; Fullenkamp, C. R.; Hart, C. R.; Parker, C. W. (Maritime Administration, Washington, D. C.). 1972.

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

The availability of all types of insurance for the SAVANNAH was investigated. Quotations which were obtained from the commercial market for both Marine Hull and Machinery insurance and Marine Protection and Indemnity insurance are presented and discussed. Since the SAVANNAH operation was completely a Government funded operation, commercial Marine Protection and Indemnity insurance was purchased in order to provide experience in a commercial operational environment to establish a firm base for underwriters to establish rates for insuring future nuclear merchant ships. However, the Government self-insured the hull due to the experimental nature of the vessel. Commercial Marine and Protection Indemnity insurance was provided during the initial demonstration period of approximately three years from 1962 to 1965 during which time the SAVANNAH carried 848 passengers and 153,691 tons of cargo while calling at 55 foreign and domestic ports. The insurance premiums and claims experience during this period are discussed and evaluated. (auth)

16799 (CONF-710532-(Vol.2), pp 1013-1025) INSURANCE OF NUCLEAR VESSELS WITH SPECIFIC REFERENCE TO THE N.S. "Otto Hahn". von Schlayer, K. F. (Allianz Versicherungs-AG, Munich). 1972. (In German and English).

From Conference on nuclear ships; Hamburg, Germany (10 May 1971).

Information on the insurance requirements of nuclear ships is presented concerning builders' risk insurance, hull insurance, and nuclear liability insurance. The insurance coverage for the Otto Hahn Reactor is described. (auth)

16800 (GKSS-72/E/6) DETERMINISTIC METHOD OF DEFINING THE APPLICABILITY OF NUCLEAR PROPULSION FOR CARGO SHIPS. Pihowicz, W. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Geesthacht (West Germany)). 1972. 44p. Dep. NTIS (U. S. Sales Only).

The economic applicability of nuclear merchant ships is discussed. A deterministic method is used which computes the independent variables, such as speed and deadweight capacity of the ship, and uses as inputs various given parameters. The nuclear merchant ship is established as economically advantageous as long as the comparative function is positive. In addition to ship size and deadweight capacity other important parameters that are considered in the analysis are type of propulsion, condition of service, and relation of costs and prices. The average yearly profits of the nuclear and the conventional ship are compared by using the comparative function. The nuclear and the conventional ships which are compared with each other are of the same geometry and have the same displacement. Special mathematical functions are developed for the analytic form of the deterministic comparative function. All relevant influence factors are considered by this comparative function, and these influence factors consist of technical as well as economic factors. (auth)

16801 LEGISLATION IMPEDING NUCLEAR SHIP DEVELOPMENT. Richards, R. A. C. Dock Harbour Auth.; 53: No. 620, 54-56(Jun 1972).

Impressions gained at the International Symposium on Nuclear Ships held in Madrid are discussed. It is considered that, com-

mercially, nuclear ships are viable in spite of legislation which greatly restricts their potential use. When the rigid controls are lifted world shipping should be greatly enhanced. Details of the Japanese nuclear ship, the Mutsu, and of the special service port built specifically for the ship were given. The obvious advantages of a nuclear ship were described. The positioning of the nuclear plant within the ship and the economic advantages were discussed. (UK)

16802 DINAMICHESKIE REZHIMY RABOTY SUDOVYKH YADERNYKH ENERGETICHESKIKH USTANOVOK. (Dynamic Operating Modes of Marine Nuclear Power Plants). Sarkisov, A. A.; Krainov, A. A.; Likhterov, B. M.; Obol'yaninov, V. V.; Puchkov, V. N. Leningrad; Izdatel'stvo Sudostroenie (1971). 272p.

Practical recommendations are given for deriving the dynamic equations for a marine nuclear power plant and for analyzing the influence of the most important parameters on the dynamic characteristics of such plants. Information is included on: problems and methods for studying the dynamics of nuclear power plants; dynamic equations for the reactor, steam generator, and external systems; methods for solving the dynamic equations on an analog computer; and emergency modes of a marine nuclear power plant. (LCL)

Process Heat and Desalination Reactors

Refer also to abstract 15210.

16803 (CONF-701214, Paper No. 31) POSSIBILITIES OF NUCLEAR HEATING IN CZECHOSLOVAKIA. Stransky, Frantisek; Dlouhy, Frantisek (Energoprojekt, Prague). 20p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A possible construction of nuclear heat generating plants in Czechoslovakia is discussed. The use of Voronezh-type pressurized-water reactors of various capacities for nuclear heat generating plants or nuclear power stations with heat output is analyzed. At present, the cities of Brno and Prague appear to be the most suitable sites for the construction of a nuclear heat source; a detailed examination of the Bratislava, Žiar nad Hronom, and Ostrava localities is recommended. Other construction sites could be at Pardubice, Zâluži, Olomouc, and Plzeň. (Nucl. Sci. Abstr. Czech.)

Research and Test Reactors

Refer also to abstracts 14791, 16496, 16497, and 16607.

16804 (AAEC/TM-624) TESTS OF EMERGENCY CORE COOLING SYSTEMS FOR HIFAR MARK IV FUEL ELEMENTS. Thompson, N. E.; Reed, N. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1972. 13p. Dep. NTIS (U. S. Sales Only).

Some tests were made of flow distribution achieved by two alternative means of emergency core cooling of HIFAR Mark IV fuel elements. These show that the fitted spray rings are not a very effective system, but that adequate cooling could probably be obtained by core flooding. (auth)

16805 (AECL-4267) KINETICS EXPERIMENTS ON COUPLED CORES IN THE ZED-2 REACTOR. Hinds, H. W.; McDonnell, F. N.; Walker, D. H. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Sep 1972. 52p. Dep. NTIS (U. S. Sales Only). AECL $1.50.

A series of space-time kinetics experiments was performed in the ZED-2 reactor. The main purpose of the experiments was to provide a set of data with which to test the adequacy of spatial kinetics codes and models used to describe the behavior of large, heavy-water-moderated power reactors. The experiments were designed to minimize excitation of the fundamental mode. A pseudo-random binary sequence was used to control the movement of two absorbers located symmetrically, one in each half of the reactor, and moving vertically in opposite directions. To increase the reactor's susceptibility to flux tilt a split-core configuration was used. The reactor response was measured using three neutron detectors. A comparison of the frequency responses derived experimentally with a point-reactor model and other, more exact models is presented. 15 references. (auth)

16806 (CEA-R-4356) SIGMA PILE OF THE GRENOBLE NUCLEAR RESEARCH CENTER. Chauvet, G.; Comera, J.; Gailliard, J. P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1972. 51p. (In French). Dep. NTIS (U. S. Sales Only).

The sigma pile of the Grenoble Nuclear Research Center consists of a two meter side graphite cube provided with six 6.5 Ci Am-Be sources. An extremely accessible local thermal flux standard is thus available. The calculations used to optimize the operation of this source and the standardization methods are described. At 20°C, the maximum thermal flux, is $7.755 \pm 0.065 \times 10^4$ neutrons/cm^2/sec. (France)

16807 (CONF-701074-8) EXPERIMENTAL STUDY OF METHODS OF DETECTING RUPTURES IN NON-HERMETICALLY SEALED FUEL ELEMENTS OF THE BR-5 REACTOR. Aristarkhov, N. N.; Efimov, I. A.; Mamaev, L. I.; Nikulin, M. P. Translated from pp 555-76 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. I. 16p. Dep. NTIS.

A system is described for verification of the hermetic seal of BR-5 reactor fuel element packets unloaded from the core into storage. The main results are presented of two mass verifications of the hermetic seal of working packets containing plutonium dioxide fuel elements, carried out in 1961 and 1965. Some regularities of the escape of gaseous fission products from fuel elements not hermetically sealed are described. The results of tests on the hermetic seal of packets containing plutonium dioxide fuel elements unloaded from the reactor into cans containing molten lead are presented. A description is presented of the method of unloading, storing, and monitoring the hermetic seal of packets of plutonium dioxide and uranium carbide in cans containing molten sodium, and also the results of verification outside the reactor under a layer of sodium of packets of the monocarbide zone of the BR-5 reactor. (auth)

16808 (CONF-701074-14) METHODS OF TESTING MATERIALS IN A HIGH-FLUX REACTOR. Tsykanov, V. A.; Samsonov, B. V. Translated from pp 140-206 of Proceedings of the Scientific and Technical Conference on Atomic Power, Fuel Cycles, and the Radiation Study of Materials, Ul'yanovsk, USSR, 5-10 October 1970, Vol. II. 53p. Dep. NTIS.

Methods for investigating materials in a high-flux reactor of the SM-2 type are described. Distinctive features of the reactor which influence the methodical principles and the organization of investigations are noted. Examples are cited of loop and capsule irradiators and equipment for investigations inside the reactor of: the mechanical properties of materials of construction; the behavior of fuel materials; the electrical engineering parameters of insulating materials, and the precision of thermocouple indications. (auth)

16809 (CONF-701214, Paper No. 2) CALCULATION OF FAST REACTOR SHIELDING. Burian, J.; Stoces, B. (Inst. of Nuclear Research, Rez, Czech.). 11p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Two methods were employed to calculate the shielding of the ZRR experimental fast reactor: a multi-group modification of the diffusion equation and the S_N method of solving the transport equation. Both methods are briefly described, and some of the results are presented. (Nucl. Sci. Abstr. Czech.)

16810 (CONF-701214, Paper No. 5) EXPERIMENTAL FAST REACTORS AS BASIC EQUIPMENT FOR RADIATION TESTING OF MATERIALS. Sulc, Vlastimil (Inst. of Nuclear Research, Rez, Czech.). 11p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The selection of fuel and cladding material which can be employed in fast reactors used for radiation testing of materials is discussed. The main trends are outlined in the development of fast reactors for these purposes in U.S.S.R., France, the U.K., and the U.S.A., and a brief description is presented of prospective types of experimental reactors. (Nucl. Sci. Abstr. Czech.)

16811 (CONF-701214, Paper No. 8) NEED FOR A MATERIALS TESTING REACTOR IN CZECHOSLOVAKIA. Zbehlik, J. (Inst. of Nuclear Research, Rez, Czech.). 11p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The necessity of building a materials testing reactor, is shown from the shortage of irradiation equipment for radiation testing of nuclear reactor materials. A brief description is given of an irradiation programme for the proposed materials testing reactor, and reasons are given for the selection of the Soviet MR research reactor for this purpose. (Nucl. Sci. Abstr. Czech.)

16812 (CONF-701214, Paper No. 11) PHYSICS CALCULATION OF THE CZECHOSLOVAK ZRR EXPERIMENTAL FAST

REACTOR. Cermak, J.; Tinka, I.; Gmittrova, E. (Inst. of Nuclear Research, Rez, Czech.). 16p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A calculation model is presented for the ZRR experimental fast reactor, and initial physical parameters are discussed with regard to the selection of the calculation method. A detailed description is given of the calculation of critical mass, of space distribution of neutron flux in the reactor core and the reflectors, of isotopic composition of the fuel during in-pile time, of the effectiveness of the control and shim rod system, and of reactivity coefficients. (Nucl. Sci. Abstr. Czech.)

16813 (CONF-701214, Paper No. 25) EXPERIMENTAL FAST REACTOR. Chlumsky, Vaclav; Havlicek, Vlastislav; Karel, Hejplik; (and others) (Skoda Works, Plzen, Czech.). 15p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The design of the 68 MW(t) experimental fast reactor, the concept of which is based on the Soviet BOR reactor, is described. The reactor is fueled with UO_2, containing 80% enriched ^{235}U. The elements are clad in stainless steel and both the primary and the intermediate circuits contain sodium as coolant; the temperature of the coolant at the outlet from the core is 640°C. The power density of the core reaches 1100 kW/liter. The design provides for two experimental loops for irradiating structural and fissionable materials. The loop channels are placed in the reflector; the capacity of the loops ranges from 100 to 500 kW, while the neutron flux is 1.2×10^{15} n/cm^2 · sec. The loops are provided with an independent sodium pumping system. (TTT)

16814 (CONF-701214, Paper No. 33) CONSTRUCTION OF AN EXPERIMENTAL FAST REACTOR IN CZECHOSLOVAKIA. Sykora, D. (Energoprojekt, Prague). 15p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Research tasks are outlined which are to be performed by the ZRR experimental fast reactor. The reactor is briefly described and its main parameters are given. Safety measures applied in the reactor are also discussed, with particular attention paid to protective coatings. The reactor building is described in detail. (Nucl. Sci. Abstr. Czech.)

16815 (CONF-701214, Paper No. 36) SR-1 RESEARCH REACTOR. Fleischhans, Jiri (Skoda Works, Plzen, Czech.); Jilek, Miroslav; Kott, Josef; (and others). 11p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A brief description is given of the SR-1 research reactor which is to be used mainly for materials testing, shielding investigation, reactor control experiments, and radioisotopes production. The pool type reactor using enriched uranium (80% of ^{235}U) will be light-water moderated and cooled. Its maximum heat output will be 20 MW. (Nucl. Sci. Abstr. Czech.)

16816 (CONF-721109-16) RECOMMENDED CONSTITUTIVE EQUATIONS FOR FFTF USE AND APPLICATION TO THE ANALYSIS OF STRUCTURES. Greenstreet, W. L. (Oak Ridge National Lab., Tenn.). 1972. Contract W-7405-eng-26. 22p. Dep. NTIS.

From International conference on nuclear solutions to world energy problems; Washington, DC (12 Nov 1972).

Discussions of constitutive equations for FFTF component design use are given. These equations are based on the current state-of-the-art and, along with the auxiliary rules established for their use, will model essential and important features of the material behavior. The inelastic analysis results described indicate that the finite-element analysis method provides an adequate tool for design analyses. In the particular examples used for discussion, the differences between calculated and experimental results were seen to be at least partially attributable to inaccuracies of the material behavior descriptions. However, the analysis method must be examined further before it can be evaluated. Combined stress conditions are much more revealing, and tests are now underway to provide combined stress data for analysis assessment purposes. (auth)

16817 (GSF-P-36) TEMPERATURE CURVE WITHIN THE CONCRETE SHIELDING OF THE DRY IRRADIATION CHAMBER OF THE FRN AFTER BREAKDOWN OF THE COOLING SYSTEM. Rau, G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H., Munich (West Germany)). Jan 1972. 8p. (In German). INIS.

A summary is presented of investigations on the heating process in the concrete shielding of the dry irradiation chamber at 1 MW operating power after a failure in the cooling system. The temperature curves for various periods of time are established by solving the interstationary heat transfer equation. The results show that it is possible to continue reactor operation after a breakdown of the cooling system up to one hour, since the temperatures within the concrete at the side of the dry irradiation chamber will have reached a maximum of only 40°C. (GF)

16818 (HEDL-TME-72-104) TRANSIENT ANALYSIS OF AN IVHM GRAPPLE IMPACT TEST. Hill, R. G. (Hanford Engineering Development Lab., Richland, Wash.). Oct 1972. Contract AT(45-1)-2170. 21p. Dep. NTIS.

Tests and analyses were performed to determine the structural adequacy of a simulated FFTF In-Vessel Handling Machine (IVHM) and a simulated FFTF fuel duct to withstand withdrawal and insertion impact loads. The IVHM-fuel duct test configuration was idealized with a lumped mass model. The non-linear effects of a Bellville spring and the free fall impact of the fuel duct on the IVHM were included. A comparison between experimental and theoretical results is presented. (auth)

16819 (KFK-1622) KINETIC REACTOR INVESTIGATIONS BY MEANS OF A CROSS CORRELATION WITH PSEUDOSTOCHASTIC REACTIVITY MODULATION. Brueckner, C. (Kernforschungszentrum, Karlsruhe (West Germany)). Jul 1972. 155p. (In German). Dep. NTIS (U. S. Sales Only).

Thesis. Submitted to Karlsruhe Univ.

Kinetic measurements were performed at the Karlsruhe Argonaut Reactor by a pseudorandom cross correlation method in which the critical reactor was excited by pseudostochastic reactivity modulation and its impulse response was determined by convolution of the neutron flux density signal measured in the reactor. The reactor was excited by means of a mechanical reactivity modulator with a magnetic drive. It allowed the generation of pseudostochastic signals with a minimum time interval Δt of 4 msec. The period of the signal selected was $1023\Delta t$; hence, a measurement simultaneously covered the time between zero and approximately 4 sec with a time resolution of 4 msec, and the frequency range between approximately 1.5 and 800 rad/sec, respectively. The errors produced in the measured results, on the one hand, by the finite width of the time interval and, on the other hand, the deviations of the excitation signal from the ideal square wave shape, are discussed. Methods are described which allow these errors to be corrected or which supply information on the necessary elimination of certain signal deformations. A one-slab loading of the Argonaut reactor was used for impulse response measurements by means of the method outlined above; on the basis of these measurements, the inverse reduced generation time of prompt neutrons, β/Λ, was determined. It turns out to be independent of the places of excitation and measurement in the physically voluminous core. In measurements of symmetrical and asymmetrical two-slab loadings, i.e., assemblies with two weakly coupled cores, most of the work was concerned with determining the coupling function as a quotient of the frequency responses of both zones. On the basis of the two-point reactor model this function is used to determine the coupling reactivities, the inverse reduced generation times of prompt neutrons and, finally, the reactivities of the two zones. (45 references) (auth)

16820 (ORNL-TM-4063) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, JULY, AUGUST, AND SEPTEMBER OF 1972. Tabor, W. H.; Hurt III, S. S. (Oak Ridge National Lab., Tenn.). Jan 1973. Contract W-7405-eng-26. 54p. Dep. NTIS.

The ORR operated at an average power level of 29.4 MW for 86.6% of the time during July, August, and September of 1972. Only one fuel element was declared spent (^{235}U content ~120 g) during the quarter, while sixteen new elements were placed in service, an apparent imbalance which might, in part, be caused by the increased burnup of the shim-rod elements which now averages about 88%. The reactor was shutdown on 18 occasions, 14 of which were scheduled. The total downtime was approximately 305 hrs, higher than usual because of several test runs. Unscheduled downtime, however, totaled only 0.617 hrs for four shutdowns. Minor difficulties were encountered with the No. 5 shim-rod drive; however, a complete inspection revealed no mechanical fault. The drive, which was replaced, had been in service for 16 months. Special tests or measurements completed during the quarter included: (1) gamma flux measurements in the core, (2) beam-hole flux measurements, (3) MoO_3 mockup flux measurement, and (4) beam flux enhancement runs. (auth)

16821 (ORNL-tr-2654) CALCULATIONS OF THE SHIELDING OF REACTOR ZRR. Translated by Frank Plasil (Oak Ridge National Lab., Tenn.), from report UJZ-2649-R. 32p. Dep. NTIS.

Calculations are presented for the γ radiation, neutron flux, and heat distributions in the ZRR Reactor shielding. 10 references. (D.C.C.)

16822 (RT/PROT-(72)17) CONTINUOUS MONITOR FOR THE AIRBORNE $\beta-\gamma$ CORPUSCULATED CONTAMINATION CONTROL. Lo Prato, E.; Moccaldi, A.; Romanin, R. (Comitato Nazionale Per L'Energia Nucleare, Rome (Italy)). 28 Jun 1972. 36p. (In Italian). Dep. NTIS (U. S. Sales Only).

A method based on the instantaneous subtraction, in forced ventilation plants, of the beta-gamma corpusculated activity of the air at the entrance of the plant from the output one is described. Characteristics and work specifications of the device, which has been applied to the 1 MW TRIGA reactor of the C.S.N. Casaccia of C.N.E.N., are presented. (auth)

16823 (SC-RR-720739) REFLECTOR CONTROL FOR FAST BURST REACTORS. Schmidt, T. R.; Reuscher, J. A. (Sandia Labs., Albuquerque, N. Mex.). Sep 1972. 31p. Dep. NTIS.

Reflector control concepts for Godiva-type fast burst reactors are explored and advantages and disadvantages are presented for each system. A theoretical upper bound is given for the reflector reactivity worth based on a U-10 w/o Mo fueled system. This leads to a simple experimental measure of the core-averaged albedo. Static reactivity worths of copper, aluminum, iron, lead and uranium reflectors of several thicknesses were measured as a function of position in Sandia Pulsed Reactor II. The measurements clearly demonstrate the potential use of reflectors as control and burst elements in fast burst reactors. (auth)

16824 (SRARI-P-131) NEUTRON CHOPPER WITH THREE SYNCHRONOUSLY ROTATING ROTORS SUSPENDED IN A MAGNETIC FIELD. Kalebin, S. M.; Rukolaine, G. V.; Artamonov, V. S.; Nikol'skii, S. N.; Kocherygin, N. G.; Pelevin, G. A. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 15p. (In Russian). Dep. NTIS (U. S. Sales Only).

The neutron chopper is described with three synchronously rotating rotors suspended in a magnetic field which is used to form the pulsed neutron beam in SM-2 reactor. The problems of the rotor stability according to their principal moment of inertia are considered. The formulas necessary for designing the rotors suspended in a magnetic field are given. The principle for operation of the tracing radiotechnical schemes providing the synchronous rotation of rotors is described. The experimental characteristics of their synchronous rotation are also presented. (auth)

16825 (STI/DOC-10/138) KINETICS AND NOISE ANALYSIS OF ZERO-POWER REACTORS: AN NPY-PROJECT REPORT. (International Atomic Energy Agency, Vienna (Austria)). Aug 1972. 110p. IAEA $4.00.

Information on kinetics and noise analysis of zero power reactors is presented under the following headings: theory of zero-power kinetics; reactivity measurements; pulsed neutron technique; neutron counting statistics analysis; and ion chamber current fluctuation analysis. (DCC)

16826 PRESENT STATUS AND FUTURE PLANS REGARDING THE DEVELOPMENT AND UTILIZATION OF PULSED REACTORS IN JAPAN. Nippon Genshiryoku Gakkaishi; 14: No. 7, 357-67(Jul 1972). (In Japanese).

The repetitively pulsed fast reactor and the one-shot thermal pulsed reactor are recognized in Japan to be the most useful future research reactors. The former calls for a carefully planned long-term program for its development, while the latter is already a proven type. A Linac Fast Booster has been adopted as an intermediate target to be aimed at in the present stage of development of the repetitively pulsed fast reactor. The specifications, preliminary design, progress in related research programs, and schedule for future developments are described. Important developments in the thermal pulsed reactor field are also reported. (auth)

16827 DEVELOPMENT OF THE FUEL HANDLING FACILITY FOR SODIUM-COOLED FAST BREEDER REACTOR. Hotta, O.; Yoshida, N. (Fuji Electric Co. Ltd., Kawasaki, Japan). Karyoku Hatsuden; 23: No. 5, 515-24(May 1972). (In Japanese).

The development and testing of a fuel exchange machine and a fuel loading and unloading machine for the experimental fast reactor "Joyo" are reported. The fuel exchange machine, which is to transfer fuel between the reactor core and the in-core storage rack, consists of a fuel gripper, driving mechanism for the gripper and door valve, and related machines such as hold-down mechanisms. The fuel loading and unloading machine, which is to transfer fuel between the in-core storage rack and the transfer rotor consists of a gripper, driving mechanism and coffin, and shifting truck. Mockup tests of the fuel exchange machine and the fuel loading and unloading machine were carried out in air and liquid sodium atmospheres. Excellent results were obtained with both machines. Further improvements are required to: wash out sodium sticking to bellows; reduce quantity of sodium sticking to the gripper of the fuel loading and unloading machine; and prevent dripping of sodium from the gripper or pot into the coffin. (Japan)

16828 MEASUREMENT OF THE TEMPERATURE OF THE NEUTRON GAS IN THE F-1 RESEARCH REACTOR. Lomakin, S. S.; Mordovskaya, T. S.; Panfilov, G. G.; (and others). Yadern. Priborostr.; No. 12, 230-6(1970). (In Russian).

The integral method of measuring the temperature of the neutron gas at different points of the large graphite reactor with natural U was examined in detail. The method consists in the detection of the ratio of the activity induced by the neutrons for the pairs of isotopes $^{176}Lu-^{55}Mn$ and $^{176}Lu-^{175}Lu$. In contrast to measurements in the reactor, the detectors were calibrated in large graphite prisms. The theoretical model of Westcott was used in the calculation of the temperature. The temperature was measured with an error of $\pm 3\%$, which result agrees well with the theoretical values. (4 tables) (tr-auth)

16829 TOKAI REACTOR SIMULATOR (TRS). Kasai, Mineo; Ogawa, Shigeru. Nippon Genshiryoku Gakkaishi; 14: No. 10, 549-58(Oct 1972). (In Japanese).

A small reactor simulator was constructed, using an analog computer and the console of JRR-1. The simulator TRS (Tokai Reactor Simulator) was designed for the reactor operation training experiment. With this simulator, experiments can be performed which give a better understanding of the spatial dependency of the in-core neutron flux, including the case of critical approach and the measurement of neutron importance. The TRS is a wide-range kinetic simulator continuously operative from startup to full power. The simulator and some examples of experiments performed therewith are described. (auth)

Production Reactors

16830 (RL-NRD-645) WATER QUALITY AND CORROSION CONTROL IN N-REACTOR. Scott, W. M.; Kratzer, W. K. (Douglas United Nuclear, Inc., Richland, Wash.). 22 Nov 1965. 70p. Dep. NTIS.

Declassified 30 May 1972.

The objective of the water quality and corrosion control program at N-Reactor is to prevent, detect, and correct corrosion problems before they become serious enough to affect plant life. The N-Reactor plant currently has four major corrosion problems: localized corrosion of the 304 stainless steel heat transfer tubes in the steam generators; pitting of some of the carbon steel components in the primary loop; diversion system valve corrosion which impairs their functioning; and fireside corrosion of auxiliary boiler tubes initiated by non-corrosion mechanisms. The general programs established to detect corrosion and coolant control problems at N-Reactor include: routine sampling and analysis of all recirculating coolant in N-Reactor; installation of corrosion monitoring facilities to evaluate corrosion in the primary, secondary, graphite and filtered water coolant systems by coupons exposed to the system environment; and visual examination of reactor components during shutdown or maintenance operation and destructive examination of components removed from the reactor. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 15140, 15177, and 15188.

16831 (ANL-Trans-922) MIGRATION OF RADIOACTIVE FISSION PRODUCTS IN $(U,Pu)O_2$ FUELS. Mouchnino, M. Translated for Argonne National Lab., Ill., from Paper 9B of Panel on the Behaviour and Chemical State of Fission Products in Irradiated Fuel, Vienna, 7-11 August 1972. 15p. (CONF-720843-6). Dep. NTIS.

The migration phenomena of radioactive fission products are studied. In all cases, the migration seems to take place in the direction of the temperature gradient. It is probably related to the displacement of bubbles either in the peripheral part of the oxide with a possibility of blocking of this migration at the base of the columnar grains in the case of substoichiometric oxides (rhodium) or in the part located in the interior of the columnar grain zone (Rh, Nb). The migration depends simultaneously on the initial stoichiometry conditions and on the temperatures attained during irradiation. Evaporation-condensation phenomena have also been demonstrated in the central channel. Cesium is redistributed between the oxide and the cladding after having migrated to the interior of the oxide in the direction of the thermal gradient. (7 references) (auth)

16832 (CONF-701214, Paper No. 6) RADIATION STABILITY OF STEELS FOR NUCLEAR REACTOR PRESSURE VESSELS. Vacek, Miroslav (Inst. of Nuclear Research, Rez, Czech.). 14p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The following types of low-alloy steels were investigated for radiation stability: carbon-manganese, manganese-nickel-molybdenum, and manganese-nickel-chrome-niobium steel. In the former type, employed for the A-1 reactor pressure vessel, joints welded by various welding techniques were also tested. Resistance to radiation embrittlement was found to increase with increasing nickel content and with vacuumizing of the steel prior to pouring. (Nucl. Sci. Abstr. Czech.)

16833 (CONF-701214, Paper No. 12) DEVELOPMENT OF A FABRICATION TECHNIQUE FOR UO_2-BASED FUEL ELEMENTS. Hamouz, V.; Kain, S.; Rubes, V. (Inst. for Nuclear Fuels, Zbraslav nad Vltavou, Czech.). 17p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Control methods used to determine the chemical and physical properties of powdered UO_2 and the final pellets are presented. The equipment used for cold-pressing, sintering and grinding the pellets is described. The dimensions of the pellets could be controlled within 0.01 mm; their density reached 94 to 97% of theoretical. The model fuel elements were prepared by loading 10 pellets into a 113-mm long aluminum tube, welding the tube under helium atmosphere; they were used to carry out irradiation experiments. In order to study the effect of the burnup, the maximum enrichment was varied in the individual elements, up to 6.5%. The other parameters studied included the influence of the radial gap between the pellets and the cladding (0.5, 1.2 and 2.0% of the pellet diameter) on the thermal gradient in the rod, and the source of the initial UO_2. (TTT)

16834 (CONF-701214, Paper No. 26) MANUFACTURE OF METALLIC URANIUM FUEL. Vaclavik, Emil (Development Plant of the Czechoslovak Uranium Industry, Mnisek pod Brdy, Czech.). 5p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

A brief description is presented of the technological processes in the manufacture of fuel elements from metallic uranium employed in the Czechoslovak uranium industry. Most processes and equipment were tested in the manufacture of fuel elements for the TR-O experimental heavy-water reactor. (Nucl. Sci. Abstr. Czech.)

16835 (EUR-4816) IRRADIATION BEHAVIOUR OF UO_2 FUEL RODS CONTAINING GADOLINIUM OXIDE AS CONSUMABLE POISON. Klersy, R.; Schuerenkaemper, A.; Simoni, O.; Schrader, K. H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Oct 1972. 48p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 70.-.

Eight UO_2/SS fuel pins poisoned with Gd_2O_3 in form of molybdenum coated microspheres have been irradiated at burnup values of 6500, 9400, and 14,000 MWD/T_U. The linear power was of about 500 W/cm and the central temperature of the fuel varied from 2000 to 2600°C. Post-irradiation analysis showed that the molybdenum coated microspheres of Gd_2O_3 remain intact when the temperature of the fuel does not exceed 1600°C. Above this temperature the Mo-coating is progressively destroyed which results in the reaction between UO_2 and Gd_2O_3. In the experiment no influence of burnup on the behaviour of the microsphere could be observed. 4 references. (auth)

16836 (EUR-4877) CALCULATIONS ON THE IN-PILE BEHAVIOUR OF FISSION GAS IN OXIDE FUELS. AN EXTENDED PARAMETRIC STUDY. Ronchi, C.; Matzke, H. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center. European Atomic Energy Community, Karlsruhe (West Germany). Inst. of Transuranium Elements). Dec 1972. 78p. Dep. NTIS (U. S. Sales Only). EUR B. Fr. 100.-.

Model calculations on fission gas behaviour and fuel swelling during reactor operation are presented. In its present form, the model allows calculation of the contribution of single gas atom diffusion to the overall fission gas behaviour. Thus the model includes gas atom diffusion, precipitation into a constant number of bubbles of variable size, multiple fission induced re-solution of gas atoms from bubbles and precipitation at grain boundaries which are regarded to be deep sinks. Numerical solutions have been obtained for many different sets of parameters for typical irradiation conditions in both fast and thermal reactors. Typical results are given. The equated quantities are the concentrations of gas in dynamical solution, in intragranular bubbles and at grain boundaries, as well as the local swelling rate. As a typical example, some calculations for a fast irradiation experiment (DS irradiation with mixed U, Pu) oxides are given which show that experimental swelling curves can be reasonably well predicted with acceptable parameters. Conversely, the comparison of calculations and experimental results can serve to better determine such important parameters as effective in-pile diffusion coefficients. 27 references. (auth)

16837 (KFK-1575) COMPUTER CODE SATURN 1a FOR FUEL RODS. Kaempf, H.; Elbel, H.; Despisch, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material- und Festkoerperforschung). Sep 1972. 60p. (In German). Dep. NTIS (U. S. Sales Only).

The computer code SATURN 1a allows the analysis of the in-pile behavior of a fuel pin. The thermal and mechanical as well as radiation effects of the fuel pin are evaluated as a function of the actual reactor operating history. The code is restricted to analyzing a pellet of the fuel pin under the assumption of axial symmetry and plane strains. 7 references. (auth)

16838 REACTOR FUEL ELEMENT CONTAINING A SOLID HOMOGENEOUS MIXTURE OF MODERATOR AND FISSIONABLE MATERIAL IN A WATER-COOLED REACTOR. Taylor, T. B.; MacReynolds, A. W.; Dyson, F. J. (to Gulf Oil Corp.). German Patent 1,263,937. 21 Mar 1972. (In German).

The fuel element contains a solid homogeneous mixture of zirconium hydride and up to 20% enriched uranium. The section above this homogeneous mixture consists of a neutron reflector material, such as beryllium, beryllium oxide, or carbon. The ratio of the number of hydrogen atoms to the number of uranium-235 atoms is to be 150:1, and, in the case of uranium being used as fuel, the content of uranium-238 should be not less than 80 wt %. Thin plates of a reactor poison, e.g. samarium, cadmium, or boral, are provided for in the middle and at the end of the fuel element. (GF)

16839 REACTOR FUEL SAFETY STUDIES. Plail, O. S. (Atomic Energy Research Establishment, Harwell, Eng.). Atom (London); No. 194, 218-220(Dec 1972).

An improtant part of the endorsement of any fuel system is a demonstration of its safety under both normal and abnormal reactor operating conditions. Endorsement for normal operating conditions is obtained as part of the normal irradiation program for fuel element development. However, the study of pin behavior under abnormal operating conditions and the study of certain pin defects under normal operating conditions are more difficult. Considerable experience has been gained at Harwell in the simulation of fuel safety problems using both computer and analogue models. (auth)

16840 PATTERN OF VARIATION IN WALL TEMPERATURE OF FUEL ELEMENT (LENGTHWISE) IN HEAT TRANSFER WITH SURFACE PSEUDOBOILING. Kafengauz, N. L.; Fedorov, M. I. This paper was summarized in At. Energ. (USSR); 31: No. 5, 506(Nov 1971) as paper No. 535/5832. (In Russian).

Full copy of this paper is held by TIC.

A study was made of the effects of pseudoboiling on the wall temperature distribution over a 30-mm long fuel element with a kerosene-type hydrocarbon. The experiments were carried out at pressures of 3 to 6 MN/m^2 and speeds of 5 to 30 m/sec. It was found that the wall temperature fell off at the exit end of the fuel element under pseudoboiling conditions; as the heat load was increased, this fall-off extended over the entire length, while the temperature distribution acquired a wavy character. Results may be explained as follows: pseudoboiling commences at sites where the temperature is higher (exit end), and this intensifies the heat transfer. The undulating temperature distribution is due to the formation of standing pressure waves of the oscillating fluid. (DLC)

16841 NUCLEAR FUEL ELEMENT. Emon, D. E.; Riley, D. R. (to United States Atomic Energy Commission). U. S. Patent 3,697,373. 10 Oct 1972. Filed 2 Jun 1970.

Overall fuel element clad strain due to fuel expansion during burnup is reduced by breaking the symmetry of the outer surface of the expanding fuel material. The inner surface of the clad is non-cylindrical so that at points of non-symmetry the slowly expanding fuel material is forced inward, thereby breaking the symmetry of the expanding fuel material and thus forming stress relieving paths. (Official Gazette)

Reactor Physics and Core Engineering

Physics

16842 (ANCR-1083) DWARF: A FEW GROUP, ONE-DIMENSIONAL, DIFFUSION THEORY PROGRAM FOR REACTOR DEPLETION WITH ADJUSTABLE REACTIVITY FEEDBACK. Putnam, G. E.; Anderson, E. C. (Aerojet Nuclear Co., Idaho

Falls, Idaho). Nov 1972. Contract AT(10-1)-1375. 100p. Dep. NTIS.

The DWARF program solves the few group, neutron diffusion theory equations, together with the Bateman equations for the concentrations of nuclides at a time point, to allow a very general one-dimensional simulation of reactor burnup, neutron irradiation, or Xenon oscillation problems. Running times for a maximum sized problem on an IBM 360 vary from a fraction of a second to many seconds depending on the number of fission source and feedback loop iterations required per time point. 11 references. (auth)

16843 (AREAEE-142) NUMERICAL SOLUTION OF WIGNER-WILKINS EQUATION-DESCRIPTION OF THERMA-CODE. Nassar, S. F.; Gaafer, M. A.; El-Cherif, A. I. (Atomic Energy Establishment, Cairo (Egypt). Reactor and Neutron Physics Dept.). 1972. 19p. Dep. NTIS (U. S. Sales Only).

THERMA-code for ICL-1905E computes the Wigner–Wilkins and the Maxwellian thermal energy spectrum of a finite homogeneous reactor moderated with light water. It averages various parameters important to thermal reactor design. The absorption cross-section, the fission cross-section, the diffusion coefficient, and the diffusion length averaged over these distributions are calculated directly. The code accepts input data from the KATE-1-library. (auth)

16844 (CONF-701214, Paper No. 1) MAXIMIZING OF THE MEAN FUEL ELEMENT BURN-UP IN A NATURAL URANIUM REACTOR. Bartosek, V. (Inst. of Nuclear Research, Rez, Czech.). 11p. (In Czech).

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The problem is formulated of maximizing the mean fuel burnup in a natural-uranium reactor with a given thickness of reactor core and reflector. For a homogeneous plate model, the solution is expressed analytically by use of the Pontryagin principle. The space distribution of local burnup and the corresponding distribution of thermal flux are shown. With the maximizing distribution, the mean burnup is 5 to 10% in excess of that with constant distribution. (Nucl. Sci. Abstr. Czech.)

16845 (ORNL-TM-3811) USER'S MANUAL FOR TASK: A GENERALIZED ONE-DIMENSIONAL TRANSPORT AND DIFFUSION KINETICS CODE. Buhl, A. R.; Lillie, R. A.; Dodds, H. L. Jr.; Hermann, O. W.; Robinson, J. C.; Hinton, R. J. (Oak Ridge National Lab., Tenn.). Dec 1972. Contract W-7405-eng-26. 118p. Dep. NTIS.

TASK is written in FORTRAN-IV, using flexible dimensioning, and is designed for computers in the IBM-360 series. A preliminary version of the program was made operational on a CDC-6600, and minimal programming will be required to extend the use of the code to other machines. TASK solves the one-dimensional multigroup form of the reactor kinetics equations, using either transport or diffusion theory and allowing an arbitrary number of delayed neutron groups. The program can also be used to solve standard static problems efficiently such as eigenvalue problems, distributed source problems, and boundary source problems. Convergence problems associated with sources in highly multiplicative media are circumvented, and such problems are readily calculable. (auth)

16846 (RT/FI-(72)18) TRANSPORT THEORY OF A MONOENERGETIC SPHERICAL REACTOR WITH REFLECTOR. Premuda, F. (Comitato Nazionale per l'Energia Nucleare, Bologna (Italy). Centro di Calcolo). 20 May 1972. 52p. Dep. NTIS (U. S. Sales Only).

The third form of the monoenergetic neutron transport Boltzmann equation was first employed to devise the integral transport equation for the total neutron flux in spherical geometry, which is of the Fredholm type and yields fundamental information about the total flux. With the aim of determining the flux distributions in a spherical two-region system, constituted by an internal homogeneous sphere surrounded by a homogeneous spherical shell, two separate integral equations for the total fluxes in the two regions were then obtained; the interaction between the two regions is accounted for by the formal known terms representing the "region first-flight neutron fluxes" due to the ingoing neutron angular fluxes at the interface. The method of the decomposition of the kernel reduces the two integral equations to two infinite algebraic linear systems; the interaction between the two regions leads finally to a single infinite algebraic system on the coefficients appearing in the analytical expressions of the total and angular fluxes. 22 references. (auth)

GENERAL

Energy Economics

Refer also to abstract 14746.

16847 (NP–19652) POWER ANNUAL REPORT, 1972. (Tennessee Valley Authority, Knoxville). 1972. 41p.

The annual report describes the activities of the system briefly. The production and sale of electric power are part of TVA's resource development program. The power program is separate from other activities; it is required to be self-supporting and self-liquidating. Power accounts are kept in accordance with the uniform system prescribed for electric utilities by the Federal Power Commission. The research effort, environment impact, expansion in fossil and nuclear fuel plants, operation statistics, and economics are discussed. Financial statements are furnished. A map of the power system is provided. (JCW)

16848 (SGAE–2040) ENERGY SUPPLY OF MANKIND: SOURCES AND EFFECTIVENESS. Gruemm, H. (Oesterreichische Studiengesellschaft fuer Atomenergie G.m.b.H., Seibersdorf). Sep 1972. 25p. (In German). (CONF-721060–1). Dep. NTIS (U. S. Sales Only).

From Conference of German Society of Physicists and Physicians; Munich, Germany (8 Oct 1972).

Energy demands and supplies on a global basis are discussed. Separate sections deal with fossil fuels and with nuclear fuel. Special emphasis is placed on environmental effects of energy production. Possible consequences of CO_2 and dust release into the atmosphere are discussed for fossil fuels. With respect to nuclear energy, the radiation burden to the population is considered as well as the storage of radioactive waste. Accidental interruptions are discussed. Removal of waste heat into the environment is surveyed. (HBG)

16849 TECHNOLOGICAL TRENDS IN THE UNITED STATES ELECTRIC-POWER INDUSTRY: A SURVEY AND EVALUATION WITH A REVIEW OF ECONOMIC IMPLICATIONS. Waltham, MA; Interdevelopment, Inc. (1971). 200p.

Results of surveys of trends in US power industry are presented in sections on technology and environment, technology and fuels, research and development, power stations and supply nets, power generation systems and equipment and transmission and distribution. (JRD)

16850 GUIDE TO NATIONAL PETROLEUM COUNCIL REPORT ON UNITED STATES ENERGY OUTLOOK. Washington, DC; National Petroleum Council (1973). 40p. (NP-19648). $1.50.

The National Petroleum Council's studies reveal that U. S. requirements for energy will approximately double between now and 1985 and will rely upon oil, gas, coal, and nuclear power to meet over 95 percent of the requirements. New domestic supplies of these four basic energy sources are not being developed fast enough to meet the needs. Basic options are to: rely on increased imports of oil and gas from overseas to meet the requirements; reduce the growth in energy demand through imposed restrictions or more efficient use of energy; and accelerate the development of domestic energy resources. The Council urges coordination of energy policies at the national level; development of realistic, graduated approaches to environmental goals; accelerated leasing of federal lands for exploration, particularly the outer continental shelf; continuation of tax incentives to encourage the finding and development of all energy supplies; maintenance of oil and uranium import controls; greater usage of electricity generated from domestic coal and uranium; relaxation of wellhead price controls in order that natural gas prices may reach a competitive market level; expanded research in certain carefully selected areas; and reliance upon private enterprise as the best and lowest cost method of meeting energy needs. Projections to the year 2000 are discussed briefly. (JCW)

Information Handling

16851 (ANL-TRANS–933) PRINCIPLES OF COMPILING A SYSTEMATIC BIBLIOGRAPHIC NUCLEAR DATA INDEX. (Gosudarstvennyi Komitet Po Ispol'Zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut.). Translated for Argonne National Lab., Il, from Russian. 20p. Dep. NTIS.

The general principles of the compilation of a systematic bibliographic nuclear data index for the purpose of storing data on EDP magnetic tape are considered. Some modifications of the present international CINDA system are proposed which allow the inclusion of data for all nuclear reactions. The principles of one approach to organizing key words are presented. For the purpose of demonstrating the possibility of such a system, data on all known research dealing with photoneutron reactions near the threshold are compiled, and the possibility of their use in the data storage of nuclear reactions in different modes is described. (auth)

16852 (ORNL-EIS–72-22(Vol.1)) ENVIRONMENTAL TERMINOLOGY INDEX: EMBEDDED HIERARCHY. VOLUME I, PRELIMINARY EDITION. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 224p. Dep. NTIS.

16853 (ORNL-EIS–72-22(Vol.2)) ENVIRONMENTAL TERMINOLOGY INDEX (PERMUTED INDEX). VOLUME II. PRELIMINARY EDITION. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 127p. Dep. NTIS.

16854 (TIC–26247) INTERNAL MAILING SYSTEM. List Monitors' Manual. Winnie, J. A. (California Univ., Livermore. Lawrence Livermore Lab.). Nov 1972. Contract W-7405-eng-48. 6p. Dep. NTIS.

Mathematics and Computers

16855 (COO–1469-214) SOME PROPOSALS FOR MODIFYING THE GRASS GRAPHICS LANGUAGE. Niverville des trois Maisons, P. E. (Illinois Univ., Urbana. Dept. of Computer Science.). Dec 1972. Contract AT(11-1)-1469. 52p. (UIUCDCS-R–72-554). Dep. NTIS.

Thesis.

A reconfiguration of the Graphical Remote Access Support System (GRASS) as developed at the University of Illinois is outlined. The new system is intended to suggest improvements or possibly replace the system currently in use (see "GRASS: Terminal User's Guide," Department of Computer Science Report No. 467, by M. J. Michel and J. Koch (Aug. 1971)). (JCW)

Miscellaneous

16856 (AAEC/TM–629) EFFECTIVE RESEARCH AND DEVELOPMENT IN THE GOVERNMENT SECTOR. Smith, R. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). 1972. 13p. (CONF-720851–1). Dep. NTIS (U. S. Sales Only).

From Conference on effective research and development; Warburton, Victoria, Australia (10 Aug 1972).

16857 (ACRH-38) SEMIANNUAL REPORT TO THE ATOMIC ENERGY COMMISSION. Gottschalk, A. (Ed.). (Argonne Cancer Research Hospital, Chicago, Ill.). Sep 1972. Contract AT(11-1)-69. 123p. Dep. NTIS.

16858 (AD–743480) BIOLOGICAL HAZARDS FROM EXPOSURE TO ELF ELECTRICAL FIELDS AND POTENTIALS. Schwan, H. P. (Naval Weapons Lab., Dahlgren, Va.). Mar 1972. 34p. (NWL-TR–2713). NTIS.

16859 (AEC-tr–7395) PRESENTATION OF PLANS OF THE ATOMIC ENERGY CONTROL BOARD FOR THE DEVELOPMENT OF NUCLEAR SCIENCE AND TECHNOLOGY IN PERU. Translation of a Peruvian report. 10p. Dep. NTIS.

After a brief description of the limited uses of nuclear technology, plans are presented for the development of nuclear energy in Peru. Areas which have problems capable of solution by nuclear methods are described, e.g., water supplies, electric power supply, food preservation, agriculture, medicine, mining, industrial processes, etc. Plans are given for building a nuclear center over a six-year period for research and development on nuclear technology. (TFD)

16860 (AEC-tr–7414) CONSIDERATIONS ON THE CHANGE OF STATE WHICH RESULTS IN THE EMBRITTLEMENT AT 475° OF IRON–CHROMIUM ALLOYS. Koester, Werner (Max-Planck-Institut fuer Metallforschung, Stuttgart (West Germany)). Translated by R. G. Mansfield (Oak Ridge National Lab., TN), from report OLS-38/72. 26p. Dep. NTIS.

16861 (AWRE–O–1/73) EXPERIMENTAL STUDY OF THE SHOCK WAVE IN FREE AIR FROM SPHERICAL CHARGES OF

TNT AND 60/40 RDX/TNT. Potter, R.; Jarvis, C. V. (Atomic Weapons Research Establishment, Aldermaston (England)). Jan 1973. 39p. Dep. NTIS (U. S. Sales Only). UK 1 pound.

16862 (BNL-17414) OVERVIEW OF PRESENT TREATMENT OF PARKINSONISM WITH LEVODOPA. Cotzias, G. C.; Mena, I.; Papavasiliou, P. S. (Brookhaven National Lab., Upton, N. Y.). 1972. 16p. (CONF-721135-1). Dep. NTIS.

16863 (BNL-17492) STRUCTURE OF BIOLOGICAL MOLECULES. Schoenborn, B. P. (Brookhaven National Lab., Upton, N. Y.). 1972. 23p. (CONF-720973-1). Dep. NTIS.

16864 (BNL-Tr-518) EFFECT OF LINE DEFECTS WITH HEAVY IMPURITY ATOMS ON THE SPECTRUM OF ELASTIC CRYSTAL VIBRATIONS. Fishman, A. Ya.; Ivanov, M. A.; Talutz, G. G. Translated by S. J. Amoretty (Brookhaven National Lab., Upton, NY), from Fiz. Metal. Metalloved.; 33: No. 1, 557-564 (1972). 16p. Dep. NTIS.

16865 (CEA-CONF-2090) CLEANING OF INDUSTRIAL WASTE FROM INCINERATOR GASEOUS EFFLUENTS. CASE OF TIRES. Brion, J.; Carpentier, S.; Chevalier, G.; Delarue, R.; Pradel, J.; Zettwoog, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 8p. (In French). (CONF-720960-1). Dep. NTIS (U. S. Sales Only).
From International symposium on chemical engineering in the service of mankind; Paris, France (3 Sep 1972).

16866 (CEA-R-3997) STUDY OF HIGH COERCIVE FORCE FILMS MADE BY VACUUM DEPOSITION OF COBALT ONTO CHROMIUM. Randet, Denis (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Oct 1970. 83p. (In French). Dep. NTIS (U. S. Sales Only).
Thesis. Submitted to Grenoble Univ. (France). Faculte des Sciences.

16867 (CEA-R-4383) DYNAMIC STUDY ON ERUPTIVE GASES. Le Guern, Francois (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Nov 1972. 175p. (In French). Dep. NTIS (U. S. Sales Only).
Thesis. Submitted to Paris Univ. (France).

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From 13th international conference on low temperature physics; Boulder, CO (20 Aug 1972).

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16875 (COO-3352-4) THERMAL NEUTRON SCATTERING STUDIES OF MOLECULAR DYNAMICS AND CRITICAL PHENOMENA IN FLUIDS AND SOLIDS. Annual Progress Report, December 1971-November 1972. Chen, S. H. (Massachusetts Inst. of Tech., Cambridge). 1972. Contract AT(11-1)-3352. 7p. Dep. NTIS.

16876 (EIR-223) INTERFACIAL FILM PROPERTY STUDIES AS RELATED TO THE PREPARATION OF GEL MICROSPHERES BY THE WATER EXTRACTION PROCESS. Bond, W. D.; Bischoff, K. (Eidgenoessisches Institut fuer Reaktorforschung, Wuerenlingen (Switzerland)). Nov 1972. 61p. Dep. NTIS (U. S. Sales Only).

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Thesis.

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16881 (IS-T-564) CRYSTAL STRUCTURE DETERMINATIONS OF 2,2'-BIPYRIDYLAMINE AND THREE COPPER(II) COMPLEXES WITH 2,2'-BIPYRIDYLAMINE. Johnson, J. E. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 113p. Dep. NTIS.
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16882 (IS-T-565) MODULATION OF ELECTRON WAVES BY MEANS OF A LASER. Stanek II, E. J. (Ames Lab., Iowa). Nov 1972. Contract W-7405-eng-82. 76p. Dep. NTIS.
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Thesis.

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Thesis.

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16899 (NP–19634) EVALUATION OF FLOW PARAMETERS FROM THE TOTAL-COUNT MEASUREMENTS IN THE CASE OF TRACER NONCONSERVATION. Hubert, Jerzy Z. (Institute of Nuclear Techniques, Krakow (Poland)). 1972. 16p. (INT–29). Dep. NTIS (U. S. Sales Only).

16900 (NP-19640) INVESTIGATION OF THE INFLUENCE OF THE ALUMINIUM CONTENT ON THE CRYSTALLOGRAPHIC AND MAGNETIC STRUCTURES OF THE $NiFe_{2-x}Al_xO_4$ FERRITE BY NEUTRON DIFFRACTION METHOD. Niziol, S. (Institute of Nuclear Techniques, Krakow (Poland)). 1972. 18p. (INT-20). Dep. NTIS (U. S. Sales Only).

16901 (ORNL-NSF-EP–36) PUBLIC ATTITUDES AND REGIONAL ENVIRONMENTAL PROBLEMS: DISTRIBUTIONS AND CORRELATES IN A SOUTHEASTERN CITY. Schuller, C. R.; Ervin, O. L. (Oak Ridge National Lab., Tenn.). Nov 1972. Contract W-7405-eng-26. 45p. Dep. NTIS.

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Thesis. Submitted to Emory Univ., Atlanta.

16903 (RD/B/N–2430) EFFECT OF INERT GAS BUBBLES ON GRAIN GROWTH IN FOILS. Hobbs, S. C. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov 1972. 14p. Dep. NTIS. (U.S. Sales Only).

16904 (RFP–1951) GUIDE TO THE ADHESIVE MANUFACTURER'S LITERATURE. Navratil, J. D. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 22 Nov 1972. Contract AT(29-1)-1106. 46p. Dep. NTIS.

16905 (RFP-Trans–127) CERTAIN CHARACTERISTICS OF SOUND EMISSION DURING VIBROPHONE TESTS. Belisario, G.; Capuamo, S.; di Pietro, A. Translated from Met. Ital.; 62: No. 1, 11-16(1970). 10p. Dep. NTIS.

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Thesis. Submitted to Carl-Wilhelm Technical Univ., Brunswick.

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